ATTACHMENT 17

Continuous Emission Monitoring System Quality Control Plan for Operations at the Chemical Agent Munitions Disposal System (CAMDS).

Site Plan 33-04E

Consisting of:

- **Attachment 17 - Page 1 through Attachment 17 - Page 64, as last revised August 2001.**

SITE PLAN 33-04E*

18 JULY 2001

CONTINUOUS EMISSION MONITORING SYSTEM QUALITY CONTROL PLAN FOR OPERATIONS AT THE CHEMICAL AGENT MUNITIONS DISPOSAL SYSTEM

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*Supersedes CAMDS Site Plan 33-04D, dated 24 August 2000

CONTINUOUS EMISSION MONITORING SYSTEM
QUALITY CONTROL PLAN FOR OPERATIONS AT
THE CHEMICAL AGENT MUNITIONS DISPOSAL SYSTEM

SITE PLAN 33-04E

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SITE PLAN 33-04E*

SECTION I. INTRODUCTION.

1. BACKGROUND.

a) The Chemical Agent Munitions Disposal System (CAMDS) was established with the mission for developing the facilities, testing, and improving new and unique demilitarization processes and equipment required to destroy obsolete chemical munitions. The CAMDS is under the direction of the Program Manager for Chemical Demilitarization (PMCD).

b) The Continuous Emissions Monitoring System (CEMS) is operated at the CAMDS site to monitor stack emission compliance with Federal and State stack emissions standards. The CEMS has been maintained and upgraded to meet or exceed best available technology through continuous Quality Control (QC) improvements. The system is operated to:

1) Provide the CAMDS site with engineering data on the operation and efficiency of the furnace systems during tests and operations.

2) Provide emission data to demonstrate EPA compliance with regulatory standards which require incinerators to have the capability to destroy those hazardous organic constituents of waste that are the most difficult to incinerate. Through continuous improvements, the proper selection of materials in contact with the sample both in the wet and dry state, and the best available technology, the CEMS can operate at CAMDS for long periods without deterioration.

c) The CAMDS CEMS is an advanced CEMS system developed through continuous quality improvement projects, research and development efforts, and is equipped with the following software subsystems:

1) Real time data system.

2) Automated reporting system.

3) Self-diagnostics system.

4) The CEMS Smart System.

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*Supersedes CAMDS Site Plan 33-04D, dated 24 August 2000.

2. OBJECTIVES.

a) Ensure control of the technical, administrative, and human factors affecting the quality of data, whether collected by instruments, electronic software, or analysis. All such control is oriented towards the reduction, elimination, and, most importantly, prevention of non-conformities. A QC policy includes the following:

   1) Satisfactory results consistent with professional standards and ethics.

   2) Continuous improvement of the process by using best available technology, method procedures, and encouraging the development of more extensive "performance based methods" which result in the best performance.

   3) Consideration of environmental requirements.

   4) Clear definition of regulatory requirements with appropriate QC measures.

   5) Preventative actions and controls to avoid dissatisfaction and improve performance.

   6) Continuous review of requirements and achievements to identify opportunities for performance improvements.

b) Demonstrate compliance with Federal and State regulations for stack emissions using engineering data from tests of the furnace systems.

c) Provide stack emission data to demonstrate EPA compliance with regulatory standards.

d) Establish the responsibility, authority, and the interaction of personnel who are involved in the CAMDS CEMS QC program.

3. REFERENCES.

a) ISO 9004-2: 1991(E) *Quality Management and Quality System Elements* - Part 2: Guideline for Services.)

b) CFR 40 Part 266.

c) CAMDS RCRA Part B Permit, Attachment 17, USACAMDS Continuous Emission Monitoring System (CEMS), August 2001

SECTION II. RESPONSIBILITIES.

1. GENERAL.

a) The responsibility and leadership for creating the environment for CEMS QC and continuous improvement extends to the highest levels of management. The CAMDS Management demonstrates the necessary leadership and commitment by their actions, allocation of resources, open communication environment, the principles of teamwork, and enabling and empowering everyone in the organization to improve their work process. (ISO 9004-2: 1991(E) *Quality Management and Quality System Elements - Part 2: Guideline for Services*.)

b) The scope of this QC plan encompasses all of the requirements for compliance and requires the involvement, commitment, and effective inter-working of all personnel in the QC program to achieve continuous improvement. While personnel with specific designated responsibilities can be instrumental in the attainment of quality, these are not the only personnel who create quality. All personnel involved in the CAMDS QC program are responsible for quality. This is particularly true for personnel with responsibility who need organizational freedom and authority to:

1) Implement the CEMS QC program.

2) Initiate action(s) to prevent the occurrence of any non-conformities relating to CEMS performance, the CEMS process of reporting emission data, and the CEMS QC plan.

3) Identify and record any problems relating to the CEMS data, the process, and the CEMS QC plan.

4) Initiate, recommend, or provide solutions through designated channels.

5) Verify the implementation of solutions and new methods.

6) Control further reporting and performance of nonconforming CEMS processes until the deficiencies or unsatisfactory conditions have been corrected.

c) To achieve these objectives, all levels of CEMS management have the responsibility to establish and maintain a QC system structure for the effective control, evaluation, and improvement of quality throughout all stages of the process. Management sets quality improvement goals in the broadest sense. During planning meetings plans are developed to provide strategic guidance and direction for meeting these quality improvement goals and implementing the QC policy. The development of QC improvement plans involves everyone in the organization. The QC plans are implemented through quality improvement projects and controlled and monitored by management. Plans for QC improvements focus on newly identified opportunities and in areas where insufficient progress has been made. The planning process has inputs from all levels of the organization, including reviews of achieved results from State and Federal regulators.

2. DIRECTOR.

a) The Director sets QC goals to ensure that the requirements for a QC plan are met and that goals, responsibilities, and authorities are explicitly defined for personnel whose activities influence CEMS activities. This includes ensuring effective CEMS owner/regulator relationships at all interfaces internal and external to the organization. Ensures the responsibility and authority defined is consistent with the means and methods necessary for achieving the stated goals.

b) The Director retains responsibility for the QC program. He designates a management representative who will have defined authority and responsibility for ensuring that all CEMS compliance requirements and the QC program are established, implemented, audited, controlled, and continually measured and reviewed for optimal performance (Figure 1, Appendix C). The program must meet requirements of CAMDS operations, inspectors, and State and Federal compliance regulators.

3. CAMDS VALIDATING OFFICER.

a) The CEMS Validating Officer is the management representative designated by the CAMDS Director. The Validating Officer has the authority and responsibility for ensuring that the CEMS regulatory requirements and the QC program are established**,** executed, audited, controlled, and continually measured and reviewed for best performance and improvement for the approval of CAMDS operations, inspectors, and State and Federal regulators. (ISO 9004 - 2:1991(E) *Quality Management and Quality System Elements - Part 2: Guidelines for Services.*)

b) The CEMS Validating Officer determines CEMS schedules and coordinates CEMS activities with CAMDS management and reports CEMS compliance for the approval of management and the CEMS regulators.

c) The CEMS Validating Officer performs independent internal evaluations through audits of the QC program to ensure the continuing suitability and effectiveness of the QC plan to achieve CEMS compliance. May serve as the CEMS Task Monitor. Specific duties include:

1) Initiate action to prevent the occurrence of any non-conformities relating to the CEMS process and the QC program.

2) Identify and record problems relating to the CEMS process and the QC plan and verify the implementation of solutions.

3) Report CEMS compliance for the approval of inspectors and regulators.

4) Ensure that all CEMS reports are precise, accurate, and meaningful.

5) Validate CEMS performance according to performance specifications and regulatory compliance.

6) Implement, direct, and validate QC improvements and research/ development projects to improve CEMS performance and data using the QC support tools and techniques explained in Appendix A.

7) Determine when out-of-control conditions exist.

8) Direct contractor activities to maintain suitability and effectiveness of the QC program.

9) Direct research/development efforts for quality improvements.

10) Clarify the tasks to be performed and the objectives to be achieved so they are understood, including how they affect quality.

11) Plan and perform required actions for the CEMS operators performing tests.

12) Document test observations.

13) Report audit results.

14) Verify the effectiveness of corrective actions taken as a result of the audit.

15) Retain and safeguard reports and documentation pertaining to audits and submit the reports as required.

4. LABORATORY SUPPORT DIVISION CHIEF AND ANALYTICAL BRANCH CHIEF.

The Laboratory Support Division Chief and Analytical Branch Chief have the responsibility to provide sufficient resources essential to the implementation of the QC program and achievement of the QC objectives (ISO 9004-2: 1991(E) Quality Management and Quality System Elements -Part 2: Guidelines for Services).

a) Provide training, resources, equipment, and organizational support.

b) Ensure effective CEMS owner/regulator relationships at all interfaces internal and external to the organization.

c) Schedule CEMS activities within the CAMDS organization.

5. CEMS CONTRACTOR.

CEMS Contractor is responsible for the daily operation of the CEMS, maintaining CEMS performance according to performance specifications, and generating daily documentation. Specific duties include:

a) Generating quality CEMS data for emission compliance verification.

b) Daily calibration/calibration drift (CD) determination.

c) Correcting malfunctions and answering alarms.

d) Conducting corrective actions and making repairs.

e) Conducting preventative maintenance checks, when established.

f) Conducting quarterly and yearly audits.

g) Installing equipment.

h) Generating documentation for daily CEMS activities report.

6. DATA CONTRACTOR.

The data contractor has the responsibility for reporting CEMS stack emission data for regulatory compliance and assisting with CEMS regulators for maintaining compliance. Specific duties include:

a) Maintaining the Environmental Protection Agency (EPA) computer used to report compliance.

b) Assisting in determining compliance with regulators.

c) Assisting with CEMS documentation for regulator approval.

7. CEMS QUALITY CONTROL INSPECTORS.

Reviews CEMS activities and QA data with the responsibility for determining the suitability and effectiveness of the QC program and maintaining regulatory compliance. Specific duties include reviewing the following CEMS activity reports:

a) Daily CD reports.

b) The CEMS operational specifications.

c) Malfunction/alarm.

d) Corrective action/repairs.

e) Quarterly and yearly audits.

SECTION III. RESOURCE MANAGEMENT.

1. PERSONNEL RESOURCES.

A most important resource in the organization is the individual member. This is especially true where the behavior and performance of the individual directly impacts on the quality of the CEMS process. As an incentive to the motivation, development, communication, and performance of these personnel, management has the responsibility to:

a) Select personnel on the basis of ability to satisfy job specifications.

b) Provide a work environment that fosters excellence and a secure work relationship.

c) Realize the potential of every member of the organization with consistent and creative work methods and by creating opportunities for greater involvement.

d) Ensure that all personnel feel that they are involved and have an influence on the quality of the CEMS process.

e) Encourage contributions, which enhance quality by giving due recognition and reward for achievement.

f) Periodically assess factors used to motivate personnel.

g) Implement career planning and development of personnel.

h) Establish actions for updating the skills of personnel.

2. MATERIAL RESOURCES.

The material resources required for CEMS operations include:

a) Spare parts supply.

b) Calibration gases, filters, pumps, and office equipment.

c) Diagnostic/test equipment.

d) QC assessment instrumentation, computer equipment, and software.

e) Operational and technical documentation.

3. TRAINING AND DEVELOPMENT.

a) Education brings awareness of the need for change and provides the means whereby change and development can be accomplished.

b) Managers are responsible for the following important elements in the development of personnel:

1) Training of personnel responsible for all phases of the CEMS process.

2) Education of personnel on the CEMS organization's quality policy, objectives, and concepts of regulatory approval.

3) Procedures for specifying and validating that personnel have received suitable training.

4) Training in process control, data collection and analysis, problem identification and analysis, corrective action and improvement, teamwork, and communication methods.

5) Performance evaluations of personnel to access their development needs and potential.

4. COMMUNICATION.

a) The CEMS personnel directly involved with CEMS regulators should have adequate knowledge and the necessary communication skills. They should be capable of forming a work team able to interact appropriately with external organizations and representatives to provide a timely and smooth running organization.

b) All levels of management are responsible for regular communication. The existence of an information system is an essential tool for communicating CEMS operations. As a minimum, communication should include:

1) Management briefings.

2) Information exchange meetings.

3) Coordinate the exchange of documented information.

4) Maintain information technology facilities.

SECTION IV. QUALITY CONTROL.

1. GENERAL.

a) The quality of the CEMS process (interrelated resources and activities which transform CEMS inputs into outputs for reporting emission compliance) relies on principles of QC, improvement, and evaluation of results. A CEMS that is scientifically solid and verifiable is fundamental to regulatory compliance and implementing and maintaining regulatory compliance with a QC plan. To achieve this goal, the CEMS sampling and analysis system must perform the following:

1) Take an accurate sample.

2) Transport the sample unmodified.

3) Measure the sample accurately.

4) Report the results.

b) The State of Utah CEMS Regulators verify CEMS compliance. The CEMS Certifying Official has the responsibility to implement the CEMS QC Site Plan, maintain CEMS performance, and certify that the CEMS meets regulatory compliance. The data from the CEMS QC program reports support these efforts. To aid in implementing and maintaining regulatory compliance, this QC plan is written according to Code of Federal Regulations (CFR) 40 Part 266 Appendix IX; ISO 9000 Quality Management; the CAMDS permit and the requirements for the State of Utah.

c) The CEMS QC improvement benefits accumulate steadily by pursuing quality improvement projects and activities in a consistent, disciplined series of steps. These steps are based on CEMS data collection and analysis, engineering lessons learned, specifically defined research efforts, and performance based methods. The QC improvement projects are a normal part of the CEMS program. In general, a CEMS QC improvement project or activity starts with the recognition of an improvement opportunity based on brainstorming, measurement of the quality, research efforts, or competitive comparisons against organizations recognized as leaders in a particular field. Once defined, the QC improvement project or activity progresses through a series of steps. These steps include research efforts in parallel with the project to define and in some cases acquiring information not available through conventional sources.

d) Operational Procedures. The QC program includes written procedures, which describe, in detail, complete, step-by-step procedures, operations, and requirements for all of the activities for CAMDS and the operators responsible for compliance monitoring. In addition, the plan encourages the owner and operators to develop and implement more extensive methods and procedures. These are performance-based methods, which have, over time, resulted in the best CEMS performance for the conditions.

e) The CEMS Documentation. All elements, requirements, and provisions incorporated in the QC plan are defined and documented as part of the organization=s overall documentation.

1) QC Manual. The manual provides a description of the QC program as a permanent record.

2) QC Plan. The plan describes the specific QC practices, resources, and sequence of activities relevant to the CEMS operation to comply with CEMS regulations.

3) Procedures. Procedures are written statements, which specify the purpose and scope of CEMS activities in the organization to meet CEMS requirements. Procedures define how the activities are to be conducted, controlled, and recorded. Procedures are easily available to personnel and understood by all those who interface with their operation.

4) Records. Records provide information on the degree of achievement of the QC objectives, analysis to identify trends, corrective action, and effectiveness. All documentation is legible, dated, clear, and readily identifiable. Methods are established to control the issue, distribution, and revision of records.

2. VALIDATION OF CEMS PERFORMANCE.

New and modified CEMS processes along with established CEMS processes must undergo internal validation by the CEMS Validating Officer before being implemented. Validation verifies that the processes are fully developed, meet the needs of the CAMDS Site, and are in accordance with the CAMDS regulatory requirements from the State of Utah and CFR 40 Part 266 Appendix IX. The process must operate under anticipated and adverse conditions and be scientifically solid and verifiable.

3. CEMS QUALITY ASSURANCE DESCRIPTION.

All elements, aspects, and components pertaining to the quality of the CEMS data are internally and externally audited and evaluated on a regular basis. The audits are carried out in order to determine whether various elements within the QC plan are effective in achieving stated objectives. In addition, provisions are made for independent review and evaluation of the QC program by competent personnel

(Figure 2, Appendix C). Findings, conclusions, and recommendations reached as a result of review and evaluation are submitted in documentary form for necessary action by CAMDS management and CEMS regulators, where required.

4. CEMS QC LOOP.

The QC procedures are established to specify the performance requirements for all CEMS processes, which are operating in the CEMS QC loop, as illustrated in Figure 3 (Appendix C). The quality of the CEMS (as seen by the regulators) is directly influenced by these specific processes as well as by actions arising by the feedback measures, which contribute to the CEMS quality improvements, namely:

a) Inspector and CEMS regulator assessment of CEMS performance.

b) CEMS audits and the implementation and effectiveness of all elements of the QC plan.

5. CONTINUOUS QC IMPROVEMENTS.

The QC improvements in this program pertain to actions taken throughout the CEMS organization to increase the effectiveness and efficiency of activities and processes to provide added benefits to both the organization and compliance regulators.

a) Methodology for Quality Improvement. The QC improvement projects or activities usually start with the recognition of an improvement opportunity. This recognition is sometimes based on measures of quality loses in comparisons against organizations recognized as leaders in a particular field or brainstorming sessions. Once defined, the quality improvement project or activity progresses through a series of steps and is often supported by research and development efforts in series with or in parallel with the project. Research/development efforts are initiated to acquire information not available through conventional sources, develop or arrive at final methods, procedures, and processes, or define operational parameters.

b) Managing Quality Improvement Projects. The application of improvement techniques will give some incremental improvements; however, their full potential can only be realized by assuring they are applied and coordinated within a structured framework sufficient for control while simultaneously allowing the latitude for independent activities.

c) Initiating Quality Improvement Projects.

1) All members of the CEMS program are involved in initiating quality improvement projects or activities. The need, scope, and importance of the quality improvement project or activity are clearly defined and demonstrated primarily through actual operating experience; increased or changing requirements; competitive comparisons "spin off" from previous research and development efforts; QC losses; and desirable performance improvements.

2) Once an improvement opportunity is identified, a person or team is organized and assigned to the project or activity. When the project involves complex areas of expertise, the team is organized to include members from different organizations within CAMDS and contractors in order to form a multi disciplinary team. Team members frequently consult manufacturers and others considered experts in their field who are willing to give advice and recommendations. With this strategy of

gaining expertise through team members, most of the knowledge required to complete a project is made available. The remaining knowledge required can be gained through research/development efforts. During this time, preventative maintenance and corrective actions are identified and implemented.

3) The CAMDS Validating Officer establishes a development schedule that is in agreement with all concerns. Provisions are made for periodic reviews of the scope, schedule, resources, and progress.

d) Validating Improvements. Validating improvements are accomplished by collecting data during and after development and analyzing the data to confirm that an improvement has been made and can be sustained over long periods of operation. The confirmatory data is collected on the sam e basis as the data collected to investigate and establish cause and effect relationships. Extra effort is made to ensure that this basis is as close to normal operations as can be made. Investigations are made for side effects, either desirable or undesirable, that may have been introduced. Specific examples of side effects include the following:

1) Changing power requirements.

2) Computer and programming changes.

3) Availability of spare parts.

4) Increased operator and troubleshooting skills.

5) Compliance requirements.

e) Sustaining Improvements. After improvements have been made and validated, they must be sustained. Attention needs to be given to changing operational specifications, operating or compliance reporting procedures, necessary education and training, and assuring these changes become a part of this QC plan. The new improvement then needs to be controlled at the new level of performance. The control is accomplished by following the QC plan, which has been updated for the new improvement.

SECTION V. CEMS PERFORMANCE.

1. VALIDATION OF CEMS PERFORMANCE.

a) The CEMS Validating Officer has the responsibility for validating the CEMS performance and data output according to the regulatory requirements of CFR 40 Part 266, CAMDS permit, and requirements for the State of Utah.

b) The method for validating CEMS performance uses the same data used to report compliance. Simply put, it uses data from the CAMDS EPA computer. These data are compared to instrument readings, chart recorders, or other reporting devices that may not have agreement or the same accuracy. Figure 4 (Appendix C) gives a description of the CEMS organizational flow. Figure 5 (Appendix C) describes the CEMS data flow within the CEMS system. Figure 6 (Appendix C) shows how the CEMS DATA System verifies data.

2. PERFORMANCE SPECIFICATIONS.

The CEMS data are required to meet the minimum performance and out-of-control CEMS specifications provided in Tables 1 and 2.

TABLE 1. PERFORMANCE SPECIFICATIONS.

	CO[1] Analyzer		O_2[2] Analyzer
	Low Range	High Range	
Calibration Drift (CD) Determination	<6 ppm[3]	<90 ppm	<0.5%[4]
Calibration Error	<10 ppm	<150 ppm	<0.5%
Response Time	<2 min[5]	<2 min	<2 min
CO Relative Accuracy	The greater of 10% of the Performance Test Method (PTM) or 10 ppm		

[1] Carbon Monoxide, [2] Oxygen, [3] parts per million, [4] percentage, [5] minute

TABLE 2. OUT-OF-CONTROL SPECIFICATIONS.

		Out-of-control after 5 days	Out-of-control at the last calibration
O_2 Calibration Drift[1]		> 1%	> 2%
CO Calibration Drift	Low Range	> 12 ppm	> 24 ppm
	High Range	> 180 ppm	> 360 ppm

[1] 40 CFR, Part 266, Appendix IX, 2.1.4.5: The calibration drift specification is used to determine corrective action. The specifications listed are twice the drift specifications.

3. REGULATORY REQUIREMENTS OF 40 CFR PART 266.

The scope of the Resource Conservation and Recovery Act (RCRA) CEMS requirements includes CEMS audits, daily CD determination, a QA program, data archives, and data assessment reports. An overview of the requirements for CEMS is shown on Figure 7 (Appendix C).

4. PERFORMANCE SPECIFICATION TEST PROCEDURES.

a) CD Test.

1) Sampling Strategy. Conduct the CD test for all the monitors at 24-hour intervals for seven consecutive days using calibration gases at the low and high-level values of the instrument range in accordance with (IAW) the following table.

TABLE 3. CALIBRATION GAS VALUES.

	Low Level	High Level
O_2 Analyzer	0	50 % to 90 % span
CO Analyzer	0	50 % to 90 % span

Low-level calibration gas value is according to CFR 40 page 266, Appendix IX, paragraph 2.1.4.2.1

1) Introduce the calibration gases in the same manner as the daily calibration procedures; pass the gas through all components used during normal sampling. If periodic adjustments are made to the zero and span calibration settings, determine the CD immediately before these adjustments are made. To meet the specification, none of the CD values will exceed the specifications for CD in Table 1. Report the test results using the CEMS data system.

b) Response Time Test.

1) Check the entire system. The gas must pass through all components used during normal sampling. Introduce the low-level calibration gas in the same manner as when calibrating. Ensure the system has stabilized [no change greater than 1 percent (%) for 30 seconds]. Switch the CEMS to the stack and wait for a stable value. Record the upscale response time required to reach 90% of the stable value.

2) Introduce a high-level calibration gas and repeat the above procedure. Repeat the entire procedure three times and determine the mean upscale and downscale response times. The longer of the two means is the CEMS response time. Report the test results using the CEMS data system.

c) Calibration Error Test.

1) Sampling Strategy. Each monitor must be challenged with EPA Protocol 1 gases [both low- and high-range carbon monoxide (CO) and oxygen (O_2)] at three measurement points within the ranges specified in Table 4.

TABLE 4. CALIBRATION ERROR CONCENTRATION RANGES.

Measurement Point	CO (ppm)		O_2 (%)
	Low range	High range	
1	0 - 40	0 - 600	0 - 2
2	60 - 80	900 - 1200	8 - 10
3	140 - 160	2100 - 2400	14 - 16

2) Operate the CEMS in the normal sampling mode as when monitoring for compliance. Introduce the calibration gas into the CEMS in the same manner as when calibrating. The gas must pass through all components used during normal sampling. Challenge the CEMS at three non-consecutive times at each measurement point. The duration of each injection must be sufficient to saturate all transport surfaces. Report the test results using the CEMS data system.

d) Relative Accuracy Test Procedure.

1) Sampling Strategy for Performance Test Method (PTM) Tests. Conduct all PTM tests with the reference CEMS. Operate the reference CEMS according to the CEMS QC plan. This is to ensure the tests yield measurements representative of the emissions from the stack or afterburner and can be correlated to the CEMS data being tested. An independent reference (Contractor) must be used for the Relative Accuracy Test.

2) PTM. The reference CEMS must be used as the PTM for O_2 and CO. This is to comply with EPA methods for O_2 and CO. Make a sample traverse of 30 minutes, sampling for 10 minutes at each of the traverse points. Locate the traverse points at 17, 50, and 83 % of the stack or afterburner diameter.

3) The CO_2 Interference Test. The CO_2 interference tests are required to be conducted on the CO nondispersive infrared (NDIR) analyzers. Introduce CO_2 gas (4% CO_2) into the CO monitor by direct injection over the range of the expected CO_2 concentration of the stack and afterburner. Acceptable performance is indicated if the CO analyzer response is less than 1% of the measurement range of the analyzer. Report the test results using the CEMS data system.

4) Number of PTM Tests. A minimum of nine sets of all necessary PTM tests must be conducted. If more tests are conducted, a maximum of three sets may be rejected. All data, including the rejected data must be reported.

5) Correlation of PTM and CEMS Data.

a) To be valid, the CEMS must start the PTM tests at the same time as the reference CEMS. This is to correlate the PTM and the CEMS data for time and duration of each PTM test run. The response time of the reference CEMS and the CEMS is sufficiently close to not require consideration in correlating. Report the test results using the CEMS data system.

b) Preprogramming of the data system reports an integrated average CO concentration for each PTM test run. The O_2 analyzer of the reference CEMS and the sample conditioning system design confirms that the pair of results are on a consistent moisture and O_2 concentration basis. The data system compares each integrated CEMS value against the corresponding average PTM value. Report the test results using the CEMS data system.

c) Acceptable performance for the CO CEMS (which incorporates the O_2 monitor) must be no greater than 10% of the mean value of the PTM results or must be within 10 ppm of the PTM results, whichever is less restrictive. The PTM CO concentrations are corrected to 7% O_2 by the CEMS data system before calculating the Relative Accuracy (RA).

6) The RA Test Period. To be valid, conduct the RA test while the furnace is operating under normal conditions. The data system can calculate for CO corrected to 7% O_2 during RA testing for CO and O_2. Conduct all RA testing; error tests, and response time tests during the 7-day CD test period.

e) The CEMS Installation and Measurement Location Specifications. The CEMS must be installed in a location in which measurements representative of the stack and afterburner emissions can be obtained and pass the RA test. The CEMS meets this specification. Drawings 1 through 6 (Appendix D) show instrument and measurement locations.

f) Stratification Test Procedures. Stratification is defined as a difference in excess of 10 % between the average concentration in the duct or stack and the concentration at any point more than 1.0 meter from the duct or stack wall. A history of testing at the CAMDS Site using EPA Method 5 has demonstrated that the CAMDS furnace systems meet satisfactory effluent stratification.

g) The CEMS Performance and Equipment Specifications.

1) Two sets of standards for CO are given; one for low-range and another for high-range measurements. The requirements for span values are listed below on Table 5 below. The high-range specifications relate to measurement and quantification of short duration high concentration peaks, while the low-range specification relate to the overall average operating condition of the furnaces. The CEMS meets this specification using dual range analyzers with auto ranging capability.

TABLE 5. CEMS SPAN VALUES FOR CO AND O_2 MONITORS.

	CO monitors		O_2 (%)
	Low range (ppm)	High range (ppm)	
Requirement	200	3000	25
CEMS Monitors	200	3000	25

2) Data collection devices must be capable of recording all readings within the CEMS measurement range and have a resolution of 0.5% of span value. This specification is met with the CEMS data system and the CAMDS EPA computer. The CEMS monitors

and data system use digital signals from the EPA computer. This method of digital-to-digital transfer of data eliminates errors associated with voltages and current. The result is the exact transfer of data.

SECTION VI. CEMS QUALITY ASSURANCE DESCRIPTION.

1. QUALITY ASSURANCE REQUIREMENTS.

In accordance with CFR 40 Part 60, Appendix IX, proper calibration, maintenance, and operation of the CEMS is the responsibility of the CAMDS Director. The CAMDS Director, through the CEMS Validating Officer, must establish a QC program to evaluate and monitor CEMS performance. For this QC Plan, all audits must be performed and evaluated according to the guidelines in paragraph V.1, *Validation Of CEMS Performance*, and all results reported using the CEMS data system. To be valid, the QC plan must accomplish the following:

a) A daily calibration check for each monitor. The calibration must be adjusted if the check indicates the instrument's CD exceeds the CD specifications.

b) A daily system audit. The audit must include a review of the calibration check data, an inspection of the recording system, an inspection of the control panel warning lights, and an inspection of the sample transport and interface system (e.g. flow meters and filters).

c) A quarterly Calibration Error (CE) test.

d) An annual performance specification test.

2. DAILY CALIBRATION CHECK.

To be valid, the calibration check must be performed as a CD test (paragraph V.4.a) and the responses compared to the performance specifications for CD. To meet the specification, none of the CD values will exceed the specification for CD in Table 1. The out-of-control determination criteria are contained in Table 2.

3. DAILY AUDIT.

a) The CEMS Self Diagnostics.

1) The CEMS automatically performs a systems audit using its self-diagnostic subsystem, managed by the CEMS Smart System. The results are reported upon request of the CEMS operator using the automated reporting system. The audit includes over 200 operating values for each monitor, values for the CEMS Sampling Conditioning System, and the Uninterruptible Power Supply (UPS) (backup power supply). The self-diagnostics audits CEMS performance on a continuous basis while operating and reporting the results to the CEMS Smart System.

2) The Smart System evaluates actual CEMS performance on a real time basis and compares the CEMS performance with the required performance specifications. If the CEMS performance falls below specifications, the Smart System directs the EPA computer to read emission data from the backup CEMS, and reports the cause of the

performance failure to the CEMS operator audibly and CEMS computer message display.

b) The CEMS Operator. Due to the CEMS Smart System, the CEMS operator evaluates CEMS performance from collective analysis of CEMS past performance and on-the-spot observations of actual CEMS performance. The collective analysis of evidence is to gain and maintain sufficient data about the CEMS process to recognize improvements and to formulate cause-and-effect relationships. The objective is to develop this ability to the degree necessary to distinguish between coincidence and cause-and-effect relationships. Relationships that, to the operator, appear to have a high degree of consistency need to be tested and confirmed. The testing and checking of these relationships is to verify the validity of the relationship, verifiable and reproducible. Examples of variables that the operator could adjust include voltages, temperatures, pressures, calibration gases, and other variables, which are directly related to relationships.

4. CEMS AUDIT (VALIDATING OFFICER).

The CEMS Validating Officer performs on-going inspection examinations of CEMS activities to ensure arrangements and whether these arrangements are implemented effectively. Examples include reviewing daily CD reports, audits, test results, comparison of results with performance specifications, desired levels of performance improvements, and regulatory requirements.

5. INTERNAL AUDIT OBJECTIVES.

The purpose of the on-going internal audit performed by the CEMS Validating Officer is:

a) Determine the conformity or nonconformity of the QC system elements with the performance specification requirements of paragraph V.1 (Validation Of CEMS Performance), CFR 40 Part 266 Appendix IX, and the CAMDS regulatory requirements.

b) Determine the effectiveness of the implemented CEMS QC program in meeting the CEMS performance requirements.

c) Assist personnel in the CEMS program with opportunities to improve the CEMS program through quality improvements.

d) Meet regulatory requirements.

e) Ensure that CAMDS audits are conducted by personnel using the same standards and equipment.

6. QUARTERLY CALIBRATION ERROR TEST.

The CEMS operators must perform a quarterly audit on the O_2 and CO monitors for both the stacks and afterburner. To be valid, the quarterly audit must be performed as a calibration error test as described in paragraph V.4.a, Calibration Error Test. To meet the specification, none of the values will exceed the specification for calibration in Table 1.

7. ANNUAL PERFORMANCE SPECIFICATION TEST.

The CEMS operators must perform an annual performance specification test on the O_2 and CO monitors for both stacks and afterburners. To be valid, the performance specification test must include the following tests.

a) CD Test - paragraph V.4.a.

b) Response Time Test - paragraph V.4.b.

c) CE Test - paragraph V.4.c.

d) Relative Accuracy Test - paragraph V.4.d.

8. AUDIT GUIDELINES.

The following guidelines should be considered in the planning for quarterly and yearly audits.

a) Inspectors and State regulators must be notified 30 days prior to an audit.

b) All quarterly audit reports and documentation must be kept on file for review by Inspectors and State regulators.

c) All yearly audit reports and documentation must be reported to the State Regulators within 30 days of the completion of the tests.

d) All test and audit reports and documentation are considered to be more representative of operating conditions when performed when furnaces are processing.

SECTION VII. CEMS EQUIPMENT AND METHODS DESCRIPTION.

1. GENERAL.

a) The CEMS System is a custom built, microprocessor based, fully automatic, continuous analysis, sample extraction system that measures O_2, CO, CO_2, SO_2, and NO_x on the furnace stacks and afterburner, with a complete backup CEMS for all operations with the CAMDS furnace systems. The CEMS is the result of quality improvement benefits accumulated steadily based on CEMS data collection and analysis, engineering lessons learned, competitive comparisons, specifically defined research/development efforts, and development of performance based methods that have shown to result in the best performance for the conditions at CAMDS. The CEMS operates automatically, continuously performing self-diagnostics on a real time basis within all the CEMS subsystems.

b) The CEMS is comprised of a microprocessor based diagnostic system, real time data system and a computer based Smart System with verbal communication capabilities, a video display with a printer readout, and digital to digital transfer of CEMS data to the CAMDS EPA computer. The major sampling element is the probe that allows extraction of representative sample from the stack effluent. During normal operation of the CEMS, the self-diagnostics

will audit all operating values of the entire CEMS on a real time basis. If CEMS performance decreases below EPA performance specifications, the CEMS Smart System will identify the problem, indicate the problem on the display and instruct the EPA computer to read emission data from the backup CEMS.

c) The CEMS consists of seven subsystems and components. They are Sample Probe and Sample Transport Lines, Sample Conditioning System, Sample/Calibrate System, CEMS Analyzers, Smart System, Self-Diagnostics System, and Real Time Data System. These subsystems are described below.

2. SAMPLE PROBE AND SAMPLE TRANSPORT LINES.

The sample probes shown in Drawings 4 and 6 (Appendix D) are designed and configured for simple construction and replacement. Each probe extracts a continuous, representative sample from the harsh extremely wet, acid- and particulate-laden stack or afterburner, and transports the sample to the heated 5-micron filter at the end of the probe where particulates are removed. The particulate-free sample enters a heated sample transport line connected to the outlet of the probe filter, and is transported to the sample conditioning system. The moisture is maintained above the dew point to keep acid from forming. Condensed moisture (H_2O) in the sample acts as a catalyst with SO_2 to form H_2SO_4. Maintaining the moisture above the dew point eliminates the catalytic action.

3. SAMPLE CONDITIONING SYSTEM.

a) The sample conditioning system shown Figure 8 (Appendix C) consists of an electronic chiller, sample pumps, permeation dryers, and moisture removal system.

b) The chiller is totally electronic in nature, and has no moving parts.

1) Moisture sensors in the chiller are incorporated into the CEMS diagnostics in conjunction with the CEMS Smart System to provide notice of failure of the chiller. Conditioning is accomplished by condensing moisture and other condensables from the particulate free sample and drying to a dew point of -25° C/13° F.

2) The sample enters the chiller from the heated transport lines, while still above the dew point, and is quickly cooled. The cooling condenses the moisture and other condensables from the sample to a dew point of 35° F/2° C. The resulting moisture and condensables are then removed from the condenser by a custom built moisture removal system, and sent to the afterburner for disposal.

3) The moisture removal system consists of an air-operated eductor (air pump) and the necessary vacuum and flow controls to operate on demand against changes in moisture content and vacuum from the afterburner. After leaving the chiller, the sample enters a combination sample polishing and coalescing filter to further clean and dry the sample before entering the Teflon-coated diaphragm sample pump.

c) The sample pump pushes the sample through a membrane dryer. Here, selective drying of the clean dry sample is made using permeation. The dryer utilizes a hydroscopic ion exchange membrane in a continuous process to dry the sample to a dew point of -25° C/13° F. This level of drying was chosen to eliminate H_2O interference with the SO_2 analyzer. After the membrane dryer, the sample is transported to a custom-built sample/calibrate system.

4. SAMPLE/CALIBRATE SYSTEM.

The sample/calibrate system switches the CEMS between the sample mode and calibrate mode by introducing either sample gases or calibration gases to the CEMS analyzers. A secondary purpose of the sample/calibrate system is to introduce calibration gases to the sample probe as an integrity check to validate the CEMS from the probe to the analyzers.

5. THE CEMS PLATFORMS AND ANALYZERS.

a) The CEMS uses the Rosemount Analytical NGA 2000 Series of modular components. The NGA 2000 offers maximum flexibility during use and maintenance and decreases space requirements. The configuration at CAMDS consists of NGA 2000 platforms and Analyzer Modules, with one platform and five Analyzer Modules each for the stacks, afterburner, and backup CEMS. The Analyzer Modules include O_2, CO, CO_2, SO_2, and NO_x.

b) The Platform is a group of components that can be assembled in many different configurations depending on the users needs. The configuration used for the CAMDS CEMS includes the following:

   1) Operator Interface Front Panel, Display, and Keypad.

   2) Distribution Assembly.

   3) Controller Circuit Board.

   4) Enclosure.

c) The Analyzer Module is a self-contained unit, complete with detector electronics (including analog-to-digital conversion), and temperature control circuitry. Sample, zero, span, exhaust, and other support gas connections are located on the rear panel of the Analyzer Module. Detection technologies for the Analyzer Modules include the following:

   1) Paramagnetic Detection (PMD) for O_2 Analyzer Modules.

   2) Chemiluminescence Detection (CLD) for NO, NOx Analyzer Modules.

   3) Nondispersive Infrared (NDIR) for CO, CO_2, and S.

d) The platform and Analyzer Modules are interconnected through a true peer-to-peer Local Area Network (LAN).

   1) The LAN is directed by microprocessors located in each module, and communicates serially through a twisted pair wire. In addition, each platform has custom designed bi-directional communications with the CAMDS Programmable Logic Controllers (PLC) and the CEMS computer (Smart System).

   2) The CEMS computer in turn has custom designed bi-directional communications with the CAMDS EPA computer. To protect the integrity of the data on the EPA computer, the data are in a read-only mode. Emission data from the CEMS to the EPA computer is by custom digital-to-digital transfer. This results in exact transfer of data. This is compared

to using conventional 4- to 20- milliamp signals and hard wiring. Incorporating this custom digital-to-digital transfer of data allows replacement of 50 hard wires with two wires for communications and data transfer functions for each CEMS System Data Highway.

6. ROUTINE OPERATION.

a) Much of the routine operation of the CEMS is performed automatically by the CEMS Smart System. For the purpose of this QC plan, the routine operation of the CEMS and the operator are addressed in terms of the operator responsibilities. The following CEMS Contractor responsibilities for routine operation remain the same for any CEMS.

1) Daily calibration and CD determination.

2) Maintenance and repair.

3) Malfunction and alarms.

b) Daily Calibration and Drift Determination.

1) There is no set time requirement for CEMS calibration adjustment, but the CD must be determined daily. The determination is according to the requirements in paragraphs V.2 and V.3 of this Site Plan. For the purpose of this plan, daily calibration is referred to as any adjustment the operator deems necessary to correct for the observed drift. This includes adjustments to voltages, temperatures, flowrates, pressures, and other parameters that effect drift.

2) The actual adjustment to the CEMS calibration is performed automatically by the CEMS, or manually by the CEMS Operator initiating a command on the computer keypad. The calibration must be adjusted for drift at the Zero and High Range values of each operating range.

c) Maintenance and Repair. The CEMS system requires very little maintenance during normal operation. Occasional maintenance requirements are:

1) Clean the intake screens on the Analyzer Modules.

2) In the CLD module, the detector block reaction chamber and sapphire window may require cleaning.

3) Inspect and replace fuses, fans, and circuit boards when required.

4) The LED bi-cell assembly source on the PMD requires adjustment (rotation) any time the Detector is disassembled.

5) Replace the CEMS particulate filters when a visual inspection reveals noticeable particulate build-up.

6) Adjustments to oscillator tune and shutter balance adjustment on the NDIR modules.

d) Malfunctions and Repair.

1) The CEMS has built in diagnostics, which evaluate performance in terms of critical values such as voltages, temperatures, pressures, vacuums, and moisture. When an unacceptable value is detected, the CEMS Smart System initiates a message on the CEMS display or a verbal message for the operator. When emissions exceed EPA set points, the EPA computer initiates a CEMS alarm. Operators must compile documentation for all CEMS malfunctions and alarms to show the following:

    a) The cause of the malfunction.

    b) The effect on CEMS performance.

    c) The corrective action performed.

    d) Valid CEMS performance after corrective action and repairs.

2) The cause of the malfunction and the effect on CEMS performance are normally documented with data from the CEMS diagnostics and the EPA computer. Valid CEMS alarms can be documented by data from the EPA computer and the CMO operating logbook for furnace operating conditions. Furnace conditions that indicate the cause of alarms are those that pertain to excessively low or high O_2 values and high CO values.

3) Corrective action is documented with information pertaining to replacement parts, adjustments, and other work performed to restore or improve the performance.

4) Valid CEMS performance and results of corrective action repairs are documented using the CEMS data system. As a minimum, the CEMS must demonstrate a valid calibration. The data for this must be the same as that used to report emissions. The CEMS Real Time Data System is intended for this purpose. Calibration data from this system uses the same data as the EPA computer. In this way, the data used to validate CEMS performance have the same accuracy as the emission data.

5) The CEMS daily logbook is used to record the documentation along with any CD reports, graphs, and data pertaining to furnace conditions.

e) Corrective Action/Maintenance.

1) The QC program requires prompt corrective action when a QC related problem is detected. Measures will be taken to eliminate or minimize recurrence of the problem. For this plan, the following is the guideline and the qualification for performing corrective action and maintenance:

    a) Identify cause and effect relationships.

    b) Identify cause and effect relationships having a high degree of consistency.

    c) Identify coincidence relationships from cause and effect relationships.

    d) Test the relationships to verify the existence and extent of the problem.

e) To initiate preventative or corrective action, the test results must be verifiable and reproducible.

2) Corrective action also includes the reworking of equipment, scrapping of unsatisfactory products, and the revision of the QC plan.

3) Quality improvements are obtained by taking preventative or corrective actions on the process with the requirement to produce either more satisfactory outputs or reduce the frequency of unsatisfactory outputs. The responsibility and authority for implementing corrective action are defined as part of this QC plan.

TABLE 6. CEMS CORRECTIVE ACTION EXTRACTION SYSTEM PROBLEMS.

COMMON PHYSICAL PROBLEMS	POSSIBLE CORRECTIVE ACTION
General: The CEMS operator will often be warned of problems by loss of signals or inconsistent readings of poor calibration response. Approaches to resolving problems largely depend on the skill of the CEMS Operator; however, some general guidelines are provided below.	
Component failure, chopper motor.	Check for excessive wear. Increase maintenance.
Loose circuit boards, poor contacts	Check for possible vibration problems. Check for excessive moisture or corrosion in exposed areas.
Large voltage drops when site equipment is started	Install transient suppressers or dedicated power transformers for monitoring system.
Electronic problems on output from instruments, no calibration responses.	Check fuses. Refer to the Manufacturer=s manual.
Improper instrument response, faulty calibration, improper or no output.	Check electronics. Ensure that cards and components are secure. Use troubleshooting guide supplied by the Manufacturer. Replace appropriate components or replace cards.
Loss of signal or low values.	Check conditioning system for plug leaks and pump failures.
Noisy, erratic signal.	Check for electronic problems or moisture in the analyzer.
Loss of linearity.	Cell contamination or leaking calibration gas.
Slow response.	Check transport lines for leaks, water, or cell failure.

TABLE 6. CEMS CORRECTIVE ACTION EXTRACTION SYSTEM PROBLEMS. (Continued)

COMMON PHYSICAL PROBLEMS	POSSIBLE CORRECTIVE ACTION
Conditioning System	
Probe plugging	Clean or replace the probe. Enter probe at a downward angle. Change the design if the problem remains.
Inadequate water removal	Increase the size of moisture removal lines at the moisture removal pump. Improve the design of the moisture pump.
Dirt and particulates in the delivery system.	Change the particulate filter.
Leaks in the sample lines.	Decrease the number of fittings as much as possible. Don=t wrench down on compression fittings too severely. Check for breaks in Teflon[7] sample lines and provide support if required to eliminate movement and kinks.
Pump failure.	Increase maintenance. Check for changes in process conditions.
Analyzers	
Internal corrosion/damage	Check moisture removal system for failure. Increase the capacity. When moisture breaks through, dismantle the analyzer. Clean, dry, and replace any effected parts. Clean and dry all sample transport lines past the condensers.
Poor response time or poor calibration values.	Increase sample flowrate. Increase time for calibration flow.
Excessive drift.	Check analyzers for dirt and water, electrical problems, lamp or source weakening, and erratic power supply.

7. CEMS DOCUMENTATION.

a) The CEMS Validating Officer is responsible for documentation and for establishing access to records for inspectors, management, and compliance regulators. This includes making changes and modifications to documents. The documentation must be sufficient to follow the achievements of the CEMS process and the effective operation of the CEMS QC plan. All CEMS documentation is generated and reported by the CEMS Data System.

b) Performance Specification Test Reports. Performance Specification Test Reports record the results of new CEMS installation tests and Yearly Audits for existing CEMS. Performance Specification Test Reports are:

(1) The Seven-Day CD Test Report.

(2) Seven-Day Drift Summary.

(3) Response Time Test Report.

(4) Calibration Error Determination Report.

(5) Calibration Error Determination Summary Report.

(6) Calibration Error Determination Raw Data.

(7) Relative Accuracy Test Report.

(8) Relative Accuracy Summary Report.

(9) Relative Accuracy Test Raw Data.

c) Quarterly audits are performed as Error Tests in three out of four calendar quarters. The Quarterly Audit Reports are the same as the Error Test Report.

d) Yearly Audits are performed as Performance Specification Test one calendar quarter. The Yearly Audit Reports are the same as the Performance Specification Test Reports.

e) Daily CEMS logs document the routine CEMS activities. Activities include daily CD determination, malfunction checks, repairs (as needed), and answering alarms.

f) Diagnostics Reports document critical operating values for the CEMS system. These reports are used primarily in place of physical inspection functions normally performed by CEMS inspectors and as a daily audit function normally performed by the CEMS operators. Diagnostics values are operator selectable from approximately five thousand separate values for the entire CEMS system.

g) The CEMS Validation Reports are used to document actual CEMS performance. Examples of data, which verify CEMS performance, include responses both to calibration gases introduced directly into the analyzers to verify analyzer performance and to calibration gases introduced into the probe as an integrity check for the entire CEMS. Other data include diagnostics to verify operating values such as voltages, temperatures, pressures, flowrates, or

vacuums. Example reports include diagnostic reports, CD reports, and actual CEMS data printed out real time.

h) Performance Graphs document CEMS performance in graph form as opposed to numerical data.

i) Calibration curves are used primarily to report actual CEMS responses compared to desired responses over some defined measurement range.

APPENDIX A.
QUALITY CONTROL SUPPORTING TOOLS AND TECHNIQUES

QUALITY CONTROL SUPPORTING TOOLS AND TECHNIQUES.

1. GENERAL.

a) Decisions based on the analysis of situations and data play a leading role in the quality improvements projects and activities. The CAMDS CEMS is equipped with a large automated data system capable of tracking CEMS operating parameters and conditions on a real time basis. Success of the CEMS operation and associated quality improvement projects and activities are enhanced by the effective application of tools and techniques developed from this database. In general, all phases of CEMS performance, including improvements, can be evaluated and documented on a real time basis.

b) Some quality improvement decisions are based on non-numerical data. Such data play a role in research, development, and management decisions. This appendix identifies some useful tools and techniques proven to be effective in properly evaluating this kind of data and arriving at useful information for decision making.

2. TOOLS AND TECHNIQUES FOR QUALITY IMPROVEMENT.

a) Data Collection Form.

1) Application. Employed to gather data systemically to obtain a clear picture of facts.

2) Description. The data collection form is a template for collecting and recording data. It promotes the collection of data in a consistent manner and facilitates analysis.

3) Procedure.

a) Establish the specific questions to be asked.

b) Identify the data needed to answer the questions.

c) Determine how the data will be analyzed.

d) Provide a form to collect the data and include:

1. Who collected the data.

2. Where, when, how data was collected.

3. Review and revise data collection form, if necessary.

b) Affinity Diagram.

1) Application. An affinity diagram is used to organize into groupings a large number of ideas, opinions, or concerns about a particular topic.

2) Description. This tool organizes the information into groupings based on the natural relationships that exist among them. The process is designed to stimulate creativity and full participation.

3) Procedure:

a) Record ideas on cards in general terms (details may prejudice the response).

b) Randomly spread cards on a table.

c) Group cards as follows:

1. Sort in related groups.

2. Limit groups to ten.

3. Make a header card of each group.

4. Place header card on top.

5. Transfer information by groups to paper.

c) Benchmarking.

1) Application. Employed to compare a process against those of recognized leaders and identify opportunities for quality improvement that will lead to a competitive edge.

2) Description. Benchmarking compares your own processes and performances against recognized leaders or other competitive comparisons. It allows the identification of targets and the establishment of priorities for preparation of plans that will lead to competitive advantages in the area identified for quality improvement.

3) Procedure:

a) Determine the item to benchmark (method, procedure, equipment, etc.).

b) Determine against whom to benchmark.

c) Collect data (on performance, etc.).

d) Organize and analyze data.

e) Establish benchmarks (opportunities for improvement).

d) Brainstorming.

1) Application. Brainstorming finds possible solutions to problems and possible quality improvements.

2) Description. Brainstorming is a technique that taps the creative thinking of the team to generate or clarify a list of ideas, problems, or issues.

3) Procedure: Two phases are involved.

a) Generation Phase. The team reviews the purpose of the brainstorming session then, the team members generate a list of ideas. The objective is to generate as many ideas as possible.

b) Clarification Phase. The team reviews the list of ideas to make sure that everyone understands all the ideas. The evaluation of ideas will occur when the brainstorming session is completed.

4) Guidelines.

a) Team members identify a facilitator.

b) The purpose of the brainstorming session is clearly stated.

c) Each team member is offered a turn, in sequence, to state a single idea.

d) Where possible, team members build on others= ideas.

e) At this stage, ideas are neither criticized nor discussed.

f) Ideas are recorded where all team members can see them.

g) This process continues until no more ideas are generated.

h) All ideas are reviewed for clarification.

e) Flowcharts.

1) Application. A flowchart is used to:

a) Describe an existing process.

b) Design a new process.

2) Description. A flowchart is a pictorial representation of the steps in a process. It is useful for investigating opportunities for improvement by gaining a detailed understanding of how the process actually works.

3) Procedure.

a) Describe the existing process:

1. Identify the start and end of the process.

2. Define the steps in the process.

3. Construct a draft flowchart to represent the process.

b) Designing a new process:

1. Identify the start and end of the process.

2. Define the steps in the process.

3. Construct a draft flowchart to represent the process.

APPENDIX B.
EXAMPLES OF CEMS REPORTS

EXAMPLES OF CEMS REPORTS

TABLE OF CONTENTS

Wednesday, Test Date												
Monitor	ZERO				SPAN – Range 1				SPAN – Range 3			
	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESPO NSE	DRIFT
O2	6:55:00	0	0.00	0.00	6:58:30	20.9	20.79	-0.11				
CO	6:55:00	0	0.00	0.00	7:00:45	177	175.95	-1.05	7:02:30	2320	2241.75	-78.25

Thursday, Test Date												
Monitor	ZERO				SPAN – Range 1				SPAN – Range 3			
	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESPO NSE	DRIFT
O2	6:26:45	0	0.07	0.07	6:30:00	20.9	20.87	-0.03				
CO	6:26:45	0	0.00	0.00	6:32:30	177	178.95	1.95	6:35:15	2320	2320.45	30.45

Friday, Test Date												
Monitor	ZERO				SPAN – Range 1				SPAN – Range 3			
	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESPO NSE	DRIFT
O2	6:53:30	0	0.09	0.09	6:56:00	20.9	21.12	0.22				
CO	6:53:30	0	0.62	0.62	6:58:45	177	175.35	2.35	7:02:30	2320	2359.50	39.59

Saturday, Test Date												
Monitor	ZERO				SPAN – Range 1				SPAN – Range 3			
	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESPO NSE	DRIFT
O2	6:19:00	0	0.08	0.08	6:22:30	20.9	20.88	-0.02				
CO	6:19:00	0	0.00	0.00	6:24:45	177	176.25	-0.75	6:27:15	2320	2280.00	-40.00

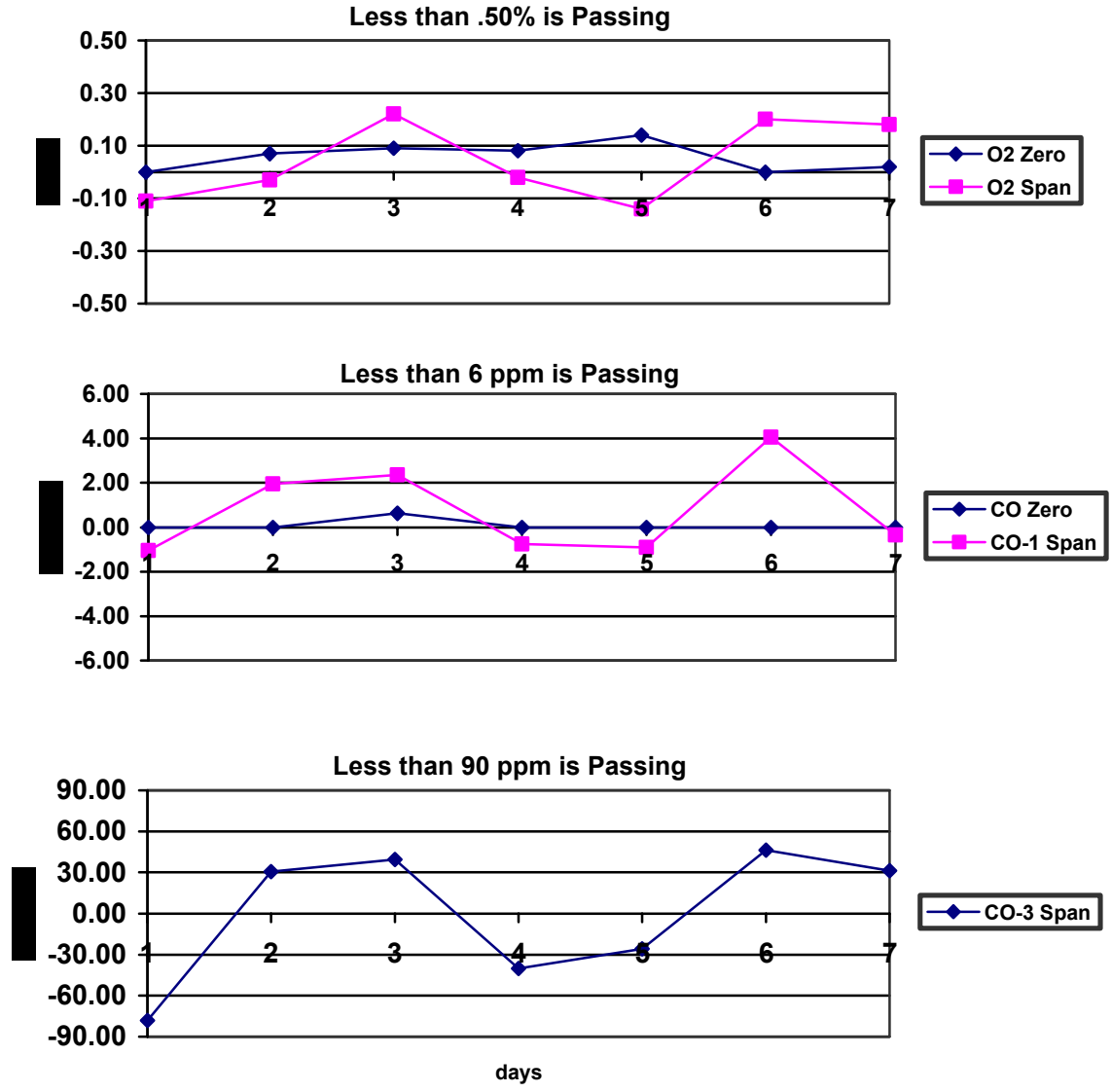
Sunday, Test Date												
Monitor	ZERO				SPAN – Range 1				SPAN – Range 3			
	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESPO NSE	DRIFT
O2	5:51:45	0	0.14	0.14	5:54:30	20.9	20.76	-0.14				
CO	5:51:45	0	0.00	0.00	5:56:00	177	176.10	-0.90	5:58:30	2320	2294.25	-25.75

Monday, Test Date												
Monitor	ZERO				SPAN – Range 1				SPAN – Range 3			
	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESPO NSE	DRIFT
O2	6:27:00	0	0.00	0.00	6:29:30	20.9	21.10	0.20				
CO	6:27:00	0	0.00	0.00	6:31:15	177	181.05	-1.05	6:33:30	2320	2366.25	46.25

Tuesday, Test Date												
Monitor	ZERO				SPAN – Range 1				SPAN – Range 3			
	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESP ONSE	DRIFT	TIME	CAL GAS	RESPO NSE	DRIFT
O2	6:44:00	0	0.02	0.02	6:47:15	20.9	21.08	0.18				
CO	6:44:00	0	0.00	0.00	6:48:45	177	176.65	-0.35	6:51:00	2320	2351.25	31.25

EXAMPLE 1. SEVEN-DAY CALIBRATION DRIFT TEST REPORT.

DAY	Date	O2 Zero	O2 Span	CO Zero	CO-1 Span	CO-3 Span
1	Test Date	0.00	-0.11	0.00	-1.05	-78.25
2	Test Date	0.07	-0.03	0.00	1.95	30.45
3	Test Date	0.09	0.22	0.62	2.35	39.50
4	Test Date	0.08	-0.02	0.00	-0.752	-40.00
5	Test Date	0.14	-0.14	0.00	-0.90	-25.75
6	Test Date	0.00	0.20	0.00	4.05	46.25
7	Test Date	0.02	0.18	0.00	-0.35	31.25
Average Drift		0.06	0.13	0.09	1.63	41.64



EXAMPLE 2. SEVEN-DAY DRIFT SUMMARY.

CEMS RESPONSE TIME TEST

SOURCE CAMDS	DATE: Test Date
MONITOR 02	LOCATION: MPF- Stack
SERIAL NUMBER 1004492	SPAN, 0-25%

CALIBRATION GAS	LOW 0	HIGH 20.9

No.	Start Time	Stop Time	Direction	Start Level	Target Level	95% of Change	Response Time (Sec)
1	9:58:45	9:59:30	Up	0	13.87	13.2	0:45
2	10:02:00	10:02:45	Down	20.9	13.85	14.2	0:45
3	10:05:15	10:06:00	Up	0	14.09	13.4	0:45
4	10:08:30	10:09:00	Down	20.9	14.01	14.4	0:30
5	10:11:15	10:12:00	Up	0	14.02	13.3	0:45
6	10:14:45	10:15:30	Down	20.9	13.98	14.3	0:45
						Average Upscale Response	0:45
						Average Downscale Response	0:45

Operator: _____ Date: _____

Validating Official : _____ Date: _____

EXAMPLE 3. RESPONSE TIME TEST REPORT.

CEMS CALIBRATION ERROR (CE) DETERMINATION

SOURCE CAMDS	DATE: Test Date
MONITOR 02	LOCATION: MPF PAS
SERIAL NUMBER 1002236	SPAN, 0-25

CALIBRATION GAS VALUES		APPENDIX IX RANGES
LOW RANGE	0.00	0-2%
MID RANGE	9.07	8-10%
HIGH RANGE	14.00	14-16%

COMPUTER TIME	RUN NUMBER	CALIBRATION VALUE	MONITOR RESPONSE	DIFFERENCE (d)		
				Low	Mid	High
10:45:30	1-LOW	0.00	0.00	0.00		
10:47:45	2-MID	9.07	8.96		0.11	
10:49:30	3-HIGH	14.00	13.95			0.05
10:51:30	4-MID	9.07	8.97		0.10	
10:53:45	5-LOW	0.00	0.00	0.00		
10:55:15	6-HIGH	14.00	13.93			0.07
10:57:15	7-LOW	0.00	0.00	0.00		
11:00:30	8-MID	9.07	8.97		0.10	
11:02:15	9-HIGH	14.00	13.96			0.04
			Mean Difference =	0.00	0.10	0.05
			Calibration Error (%) =	0.00%	0.41%	0.21%
			Pass/Fail	Pass	Pass	Pass

Performance Specification; |mean difference <= 0.5

Operator: _____ Date: _____

Validating Official : _____ Date: _____

EXAMPLE 4. CALIBRATION ERROR DETERMINATION REPORT.

CEMS CALIBRATION ERROR (CE) DETERMINATION SUMMARY

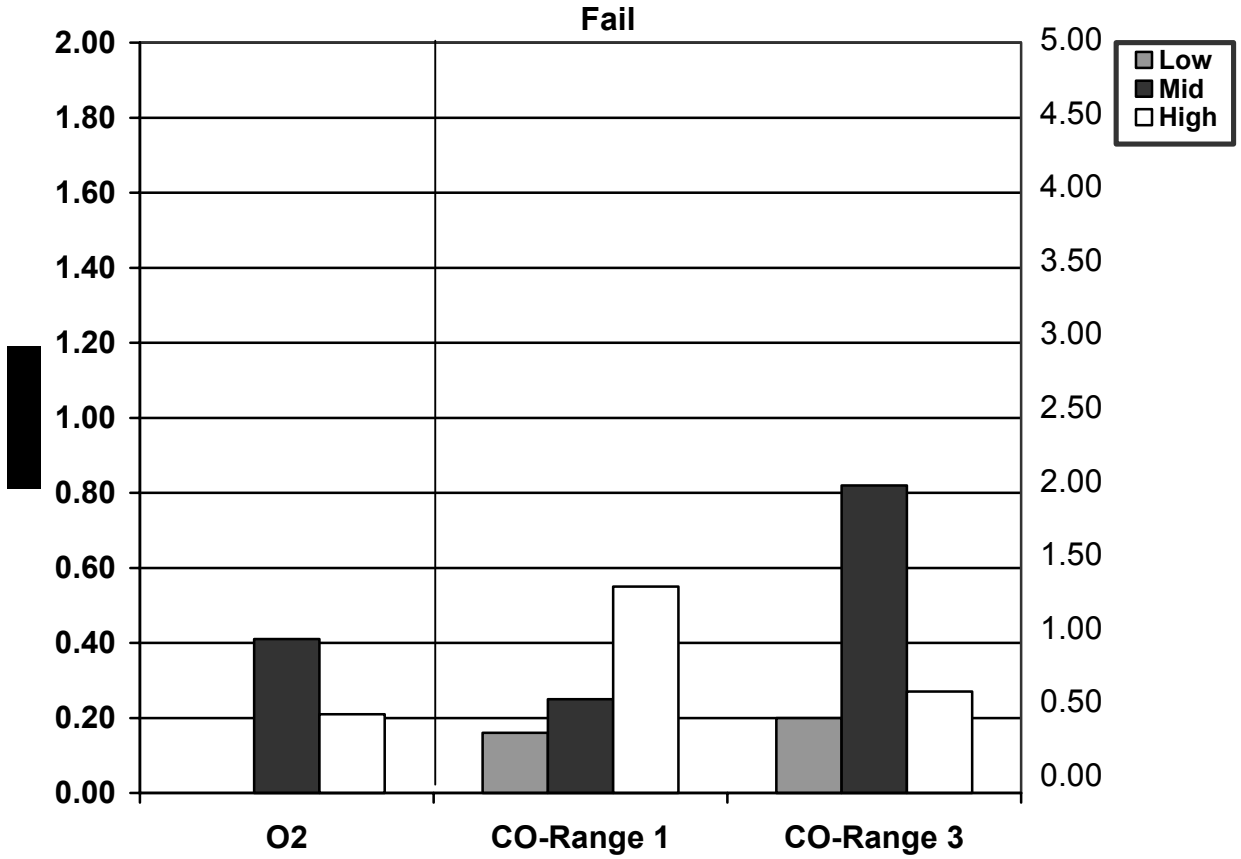
(Ref: 40 CFR 266, Appendix IX, 2.1.10.3)

Test Reference: 40 CFR, Appendix IX, 2.1.2.8; 2.1.4.7; 2.1.6.3; 2.1.7.5

Test Results

Monitor	Date	Span	Calibration Gas Range*	Calibration Gas	Mean Difference	Calibration Error (%)	Result
O_2	21 Jan, 1997	0-25%	0-2%	0.00	0.00	0.00%	**Pass**
			8-10%	9.07	0.10	0.41%	**Pass**
			14-16%	14.00	0.05	0.21%	**Pass**
CO- Range 1	21 Jan, 1997	0-200ppm	0-40 ppm	0.00	0.81	0.41%	**Pass**
			60-80 ppm	62.50	1.25	0.63%	**Pass**
			140-160 ppm	150.00	2.77	1.38%	**Pass**
CO-Range 3	21 Jan, 1997	0-3000ppm	0-600 ppm	178.00	14.57	0.49%	**Pass**
			900-1200 ppm	989.00	61.88	2.06%	**Pass**
			2100-2400 ppm	2300.00	20.25	0.68%	**Pass**

* Gas Concentration Range from 40 CFR 266, Appendix IX, Table 2. 1-3



EXAMPLE 5. CALIBRATION ERROR DETERMINATION SUMMARY REPORT.

YEARLY AUDIT – Test Date
CEMS Relative Accuracy Test
Metal Parts Furnace (MPF)

CO Summary

Data	Time	Inst. Data (mean ppm)[1]	Corr. Inst (mean ppm)	RM[2]Data (mean ppm)	Corr[3] RM (mean pp,[4])	Diff[5] (d-bar[6])	Corr Diff (d-bar)	Pass Fail
Test 1	08:45-09:15	1.63	3.67	3.52	8.39	-1.89	-4.72	Pass
Test 2	09:45-10:15	2.01	4.60	2.17	5.19	-0.16	-0.59	Pass
Test 3	10:29-10:59	2.04	4.68	2.92	6.40	-0.88	-1.72	Pass
Test 4	11:14-11:44	2.59	5.93	3.16	6.95	-0.57	-1.02	Pass
Test 5	11:58-12:28	2.92	6.68	2.56	5.63	0.37	1.05	Pass
Test 6	12:43:19:26	3.82	8.67	2.39	5.25	1.43	3.42	Pass
Test 7	13:31-14:01	4.82	10.89	2.12	4.62	2.71	6.27	Pass
Test 7	14:16-14:46	4.33	9.76	3.05	6.66	1.28	3.10	Pass
Test 9	15:00-15:30	4.34	9.78	2.74	5.97	1.60	3.82	Pass
	MEAN	3.17	7.18	2.74	6.12	0.43	1.07	Pass

Standard Deviation = Sd =	1.45	3.40
Confidence Coefficient = CC =	0.97	2.29
Relative Accuracy = RA =	51.33%	54.82%

O2 Summary

Data	Time	Inst. Data (mean%)	RM Data (mean%)	Diff (d-bar)	Pass Fail
Test 1	08:45-09:15	14.78	15.12	-0.35	Pass
Test 2	09:45-10:15	14.89	15.13	-0.24	Pass
Test 3	10:29-10:59	14.89	14.62	0.27	Pass
Test 4	11:14-11:44	14.88	14.63	0.25	Pass
Test 5	11:58-12:28	14.87	14.64	0.23	Pass
Test 6	12:43:19:26	14.84	14.63	0.20	Pass
Test 7	13:31-14:01	14.80	14.59	0.21	Pass
Test 7	14:16-14:46	14.79	14.58	0.20	Pass
Test 9	15:00-15:30	14.79	14.59	0.20	Pass
	MEAN	14.84	14.73	0.11	Pass

Standard Deviation = Sd =	0.231
Confidence Coefficient = CC =	0.155
Relative Accuracy = RA =	1.79%

EXAMPLE 6. RELATIVE ACCURACY SUMMARY REPORT.

Metal Parts Furnace Raw Data - Test Date															
	PAS					*Afterburner*					*back-up*				
Time	O_2	CO	CO_2	SO_2	NO_X	O_2	CO	CO_2	SO_2	NO_X	O_2	CO	CO_2	SO_2	NO_X
10:57:30	0.00	0.00	0.00	144.46	0.08	12.74	10.12	0.00	0.00	0.00	12.42	3.85	0.00	0.00	0.00
10:57:45	0.00	0.00	0.00	144.98	0.00	12.74	10.35	0.00	0.00	0.00	12.43	3.23	0.00	0.00	0.00
10:58:00	12.00	0.00	3.58	144.89	0.00	12.73	10.69	0.00	0.00	0.00	12.42	3.34	0.00	0.00	0.00
10:58:15	13.74	0.00	3.60	162.15	27.30	12.73	10.53	0.00	0.00	0.00	12.43	3.53	0.00	0.00	0.00
10:58:30	13.87	0.00	3.61	163.86	27.70	12.72	10.65	0.00	0.00	0.00	12.44	3.82	0.00	0.00	0.00
10:58:45	13.88	0.00	3.63	164.44	29.02	12.72	1.050	0.00	0.00	0.00	12.42	3.47	0.00	0.00	0.00
10:59:00	13.91	0.00	3.61	164.56	28.50	12.77	10.61	0.00	0.00	0.00	12.43	3.48	0.00	0.00	0.00
10:59:15	13.90	0.00	3.63	164.19	28.00	12.77	10.59	0.00	0.00	0.00	12.46	3.47	0.00	0.00	0.00
10:59:30	13.90	0.00	3.63	136.54	28.50	12.77	10.32	0.00	0.00	0.00	12.46	3.49	0.00	0.00	0.00
10:59:45	10.75	0.00	0.00	164.93	28.45	12.77	10.20	0.00	0.00	0.00	12.47	3.56	0.00	0.00	0.00
11:00:00	9.15	0.00	0.00	148.76	2.42	12.77	10.30	0.00	0.00	0.00	12.46	3.33	0.00	0.00	0.00
11:00:15	8.98	0.00	0.00	144.07	0.43	12.78	10.35	0.00	0.00	0.00	12.47	3.82	0.00	0.00	0.00
11:00:30	8.97	0.00	0.00	142.50	0.38	12.79	10.47	0.00	0.00	0.00	12.47	3.45	0.00	0.00	0.00
11:00:45	8.96	0.00	0.00	140.44	0.17	12.79	10.52	0.00	0.00	0.00	12.48	3.36	0.00	0.00	0.00
11:01:00	8.90	0.00	0.00	139.56	0.70	12.78	10.27	0.00	0.00	0.00	12.47	3.22	0.00	0.00	0.00
11:01:15	13.12	0.00	3.36	145.11	0.35	12.78	10.62	0.00	0.00	0.00	12.46	3.10	0.00	0.00	0.00
11:01:30	13.59	0.00	3.37	155.04	25.42	12.77	10.31	0.00	0.00	0.00	12.47	3.03	0.00	0.00	0.00
11:01:45	13.71	0.00	3.37	158.77	25.98	12.79	10.39	0.00	0.00	0.00	12.48	2.91	0.00	0.00	0.00
11:02:00	13.95	0.00	0.00	154.88	26.92	12.76	10.53	0.00	0.00	0.00	12.48	3.27	0.00	0.00	0.00
11:02:15	13.96	0.00	0.00	143.23	0.70	12.77	10.35	0.00	0.00	0.00	12.48	3.53	0.00	0.00	0.00
11:02:30	13.96	0.00	0.00	142.57	0.15	12.79	10.35	0.00	0.00	0.00	12.49	3.05	0.00	0.00	0.00

EXAMPLE 7. RELATIVE ACCURACY TEST RAW DATA.

APPENDIX C.
FIGURES

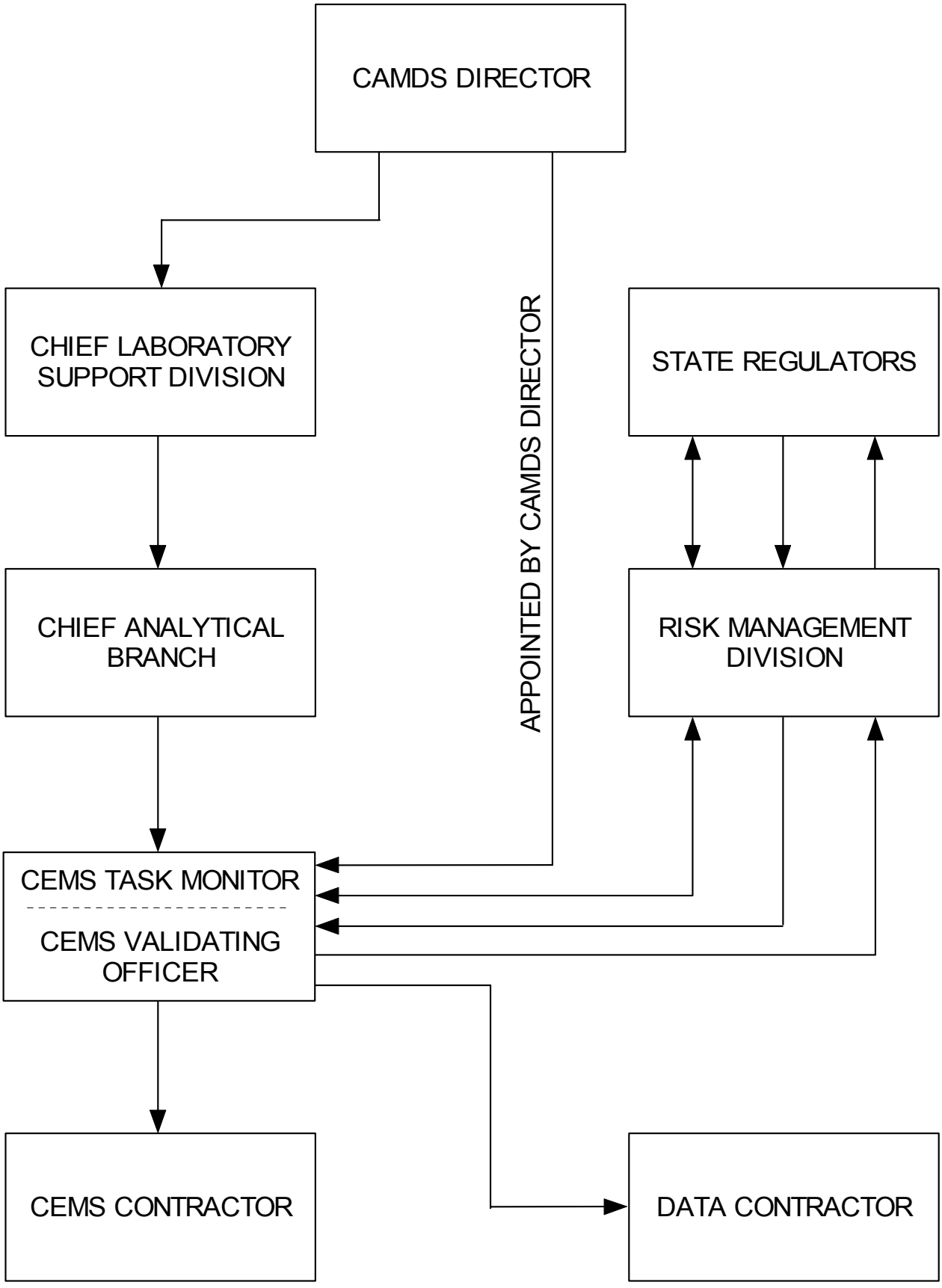


FIGURE 1. ORGANIZATIONAL RESPONSIBILITIES AND AUTHORITIES.

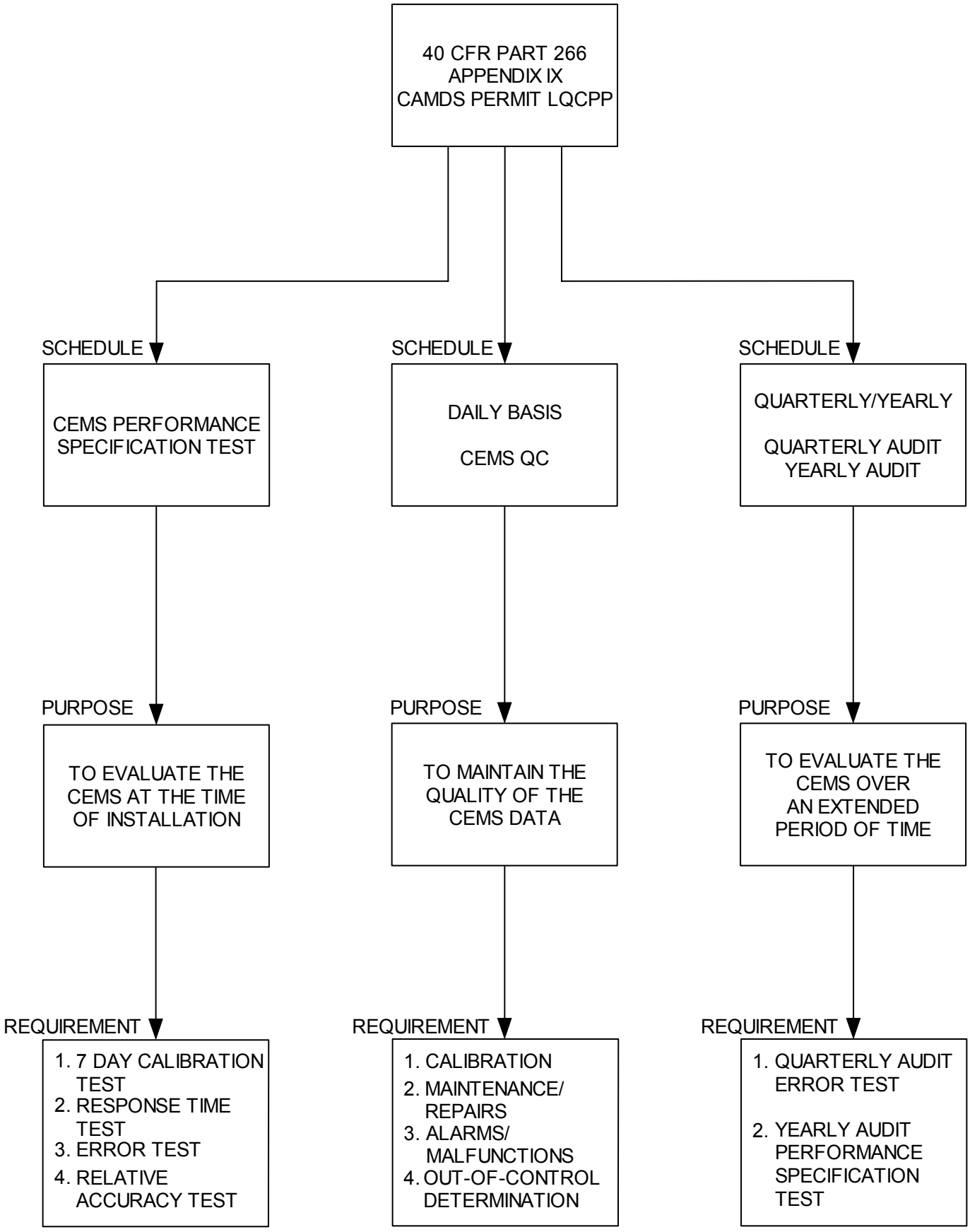


FIGURE 2. OVERVIEW OF CEMS REQUIREMENTS

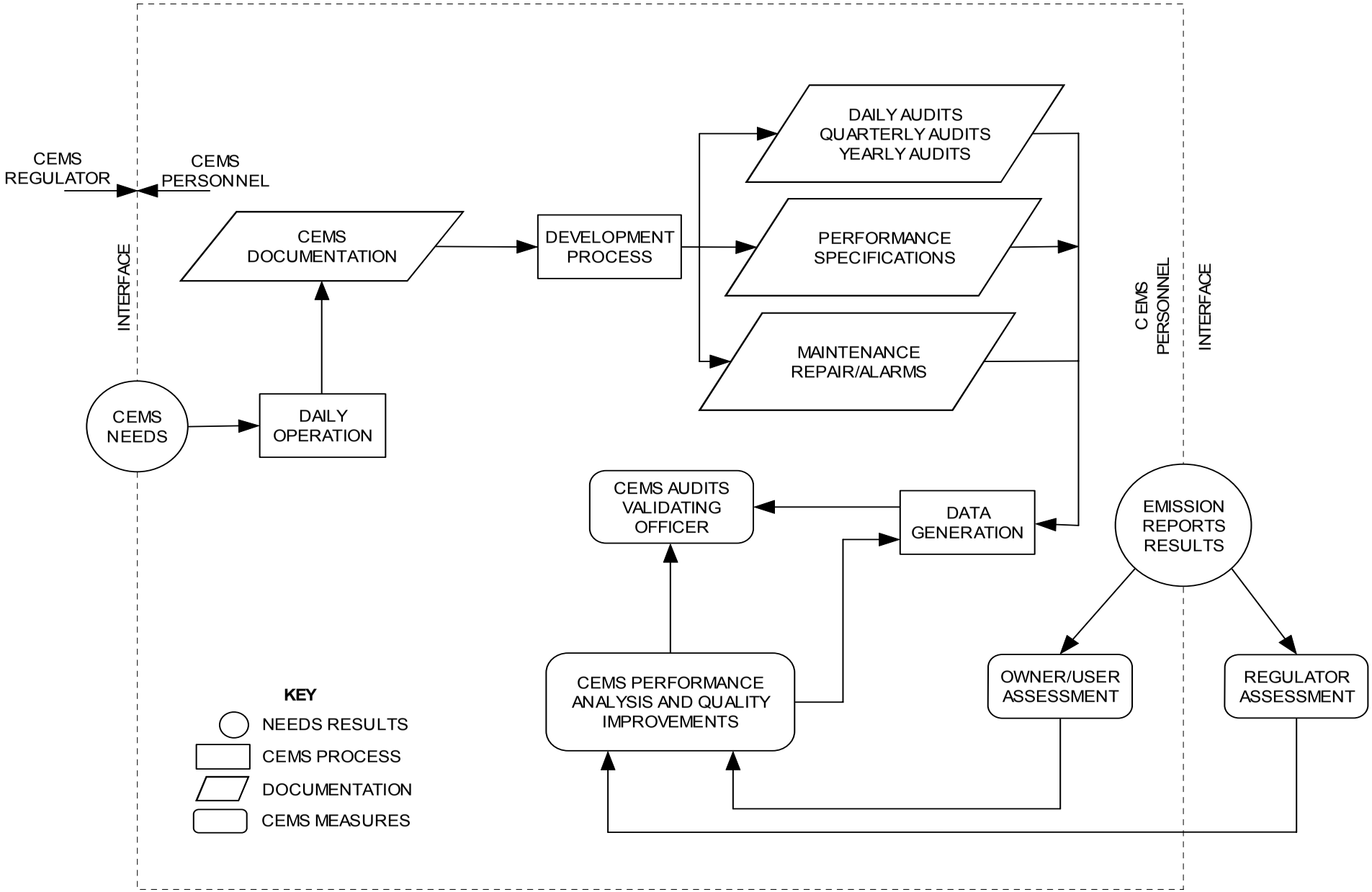


FIGURE 3. QUALITY CONTROL LOOP

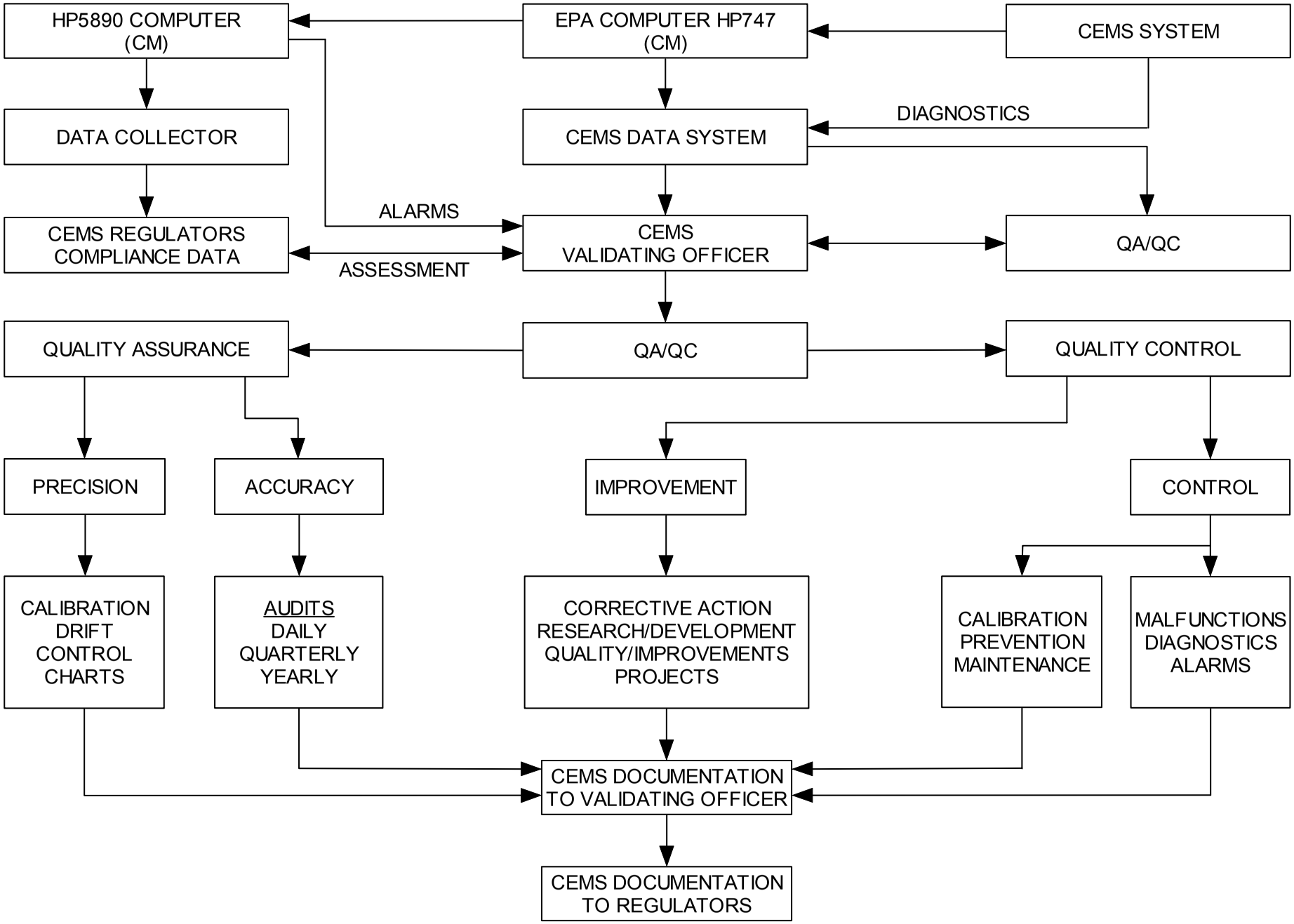


FIGURE 4. CEMS ORGANIZATIONAL DATA FLOW

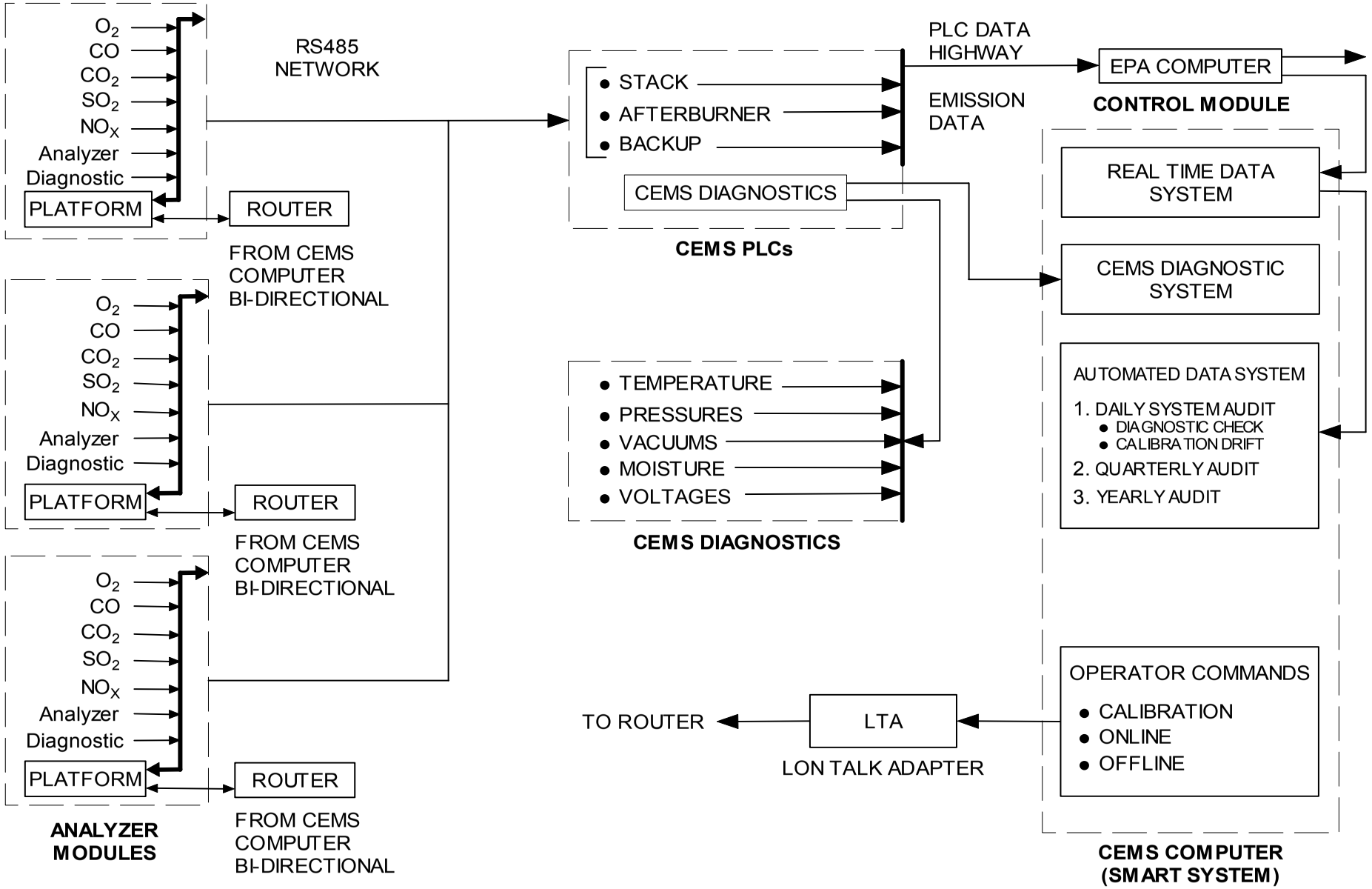


FIGURE 5. CEMS DATA VERIFICATION SYSTEM.

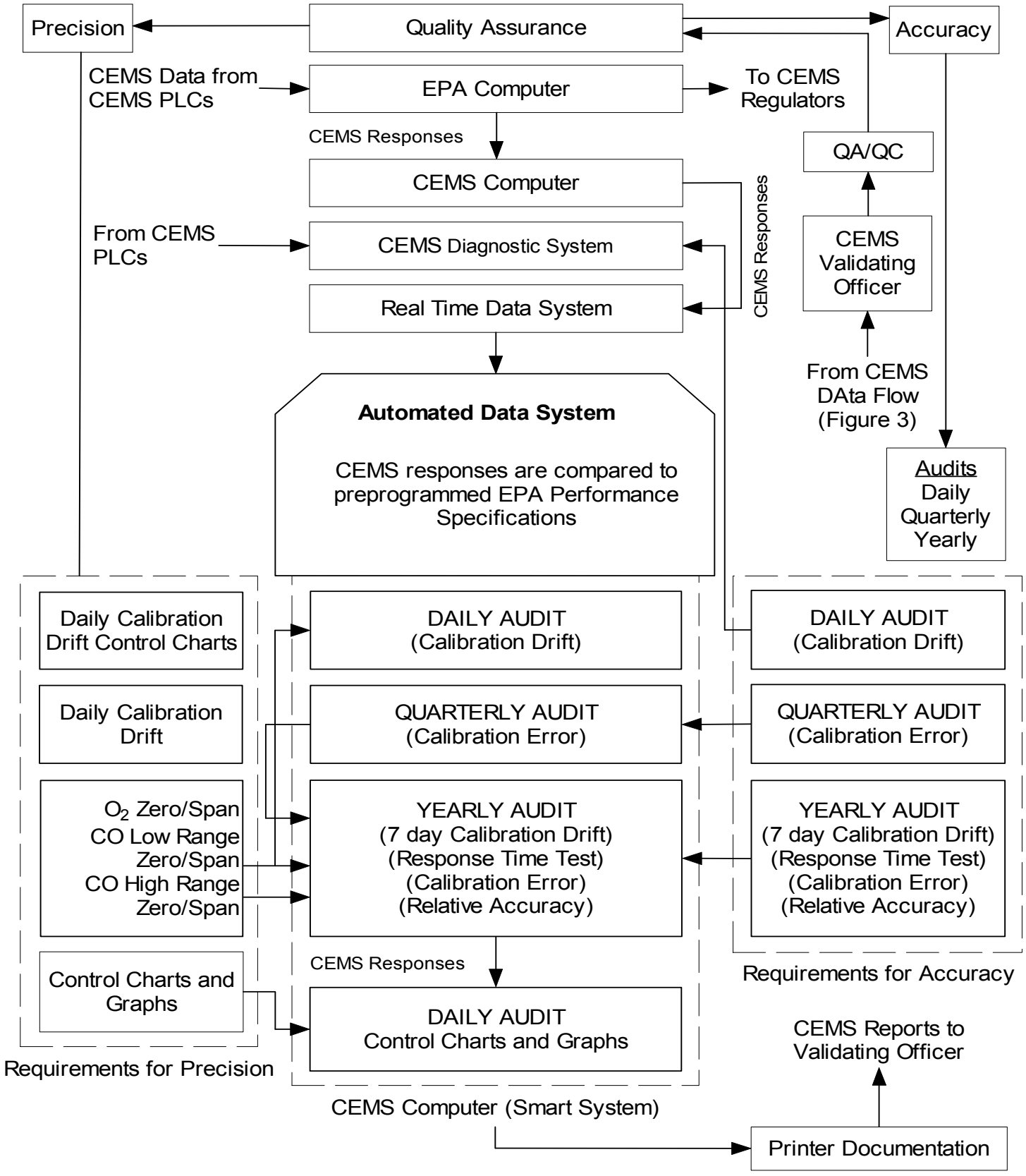
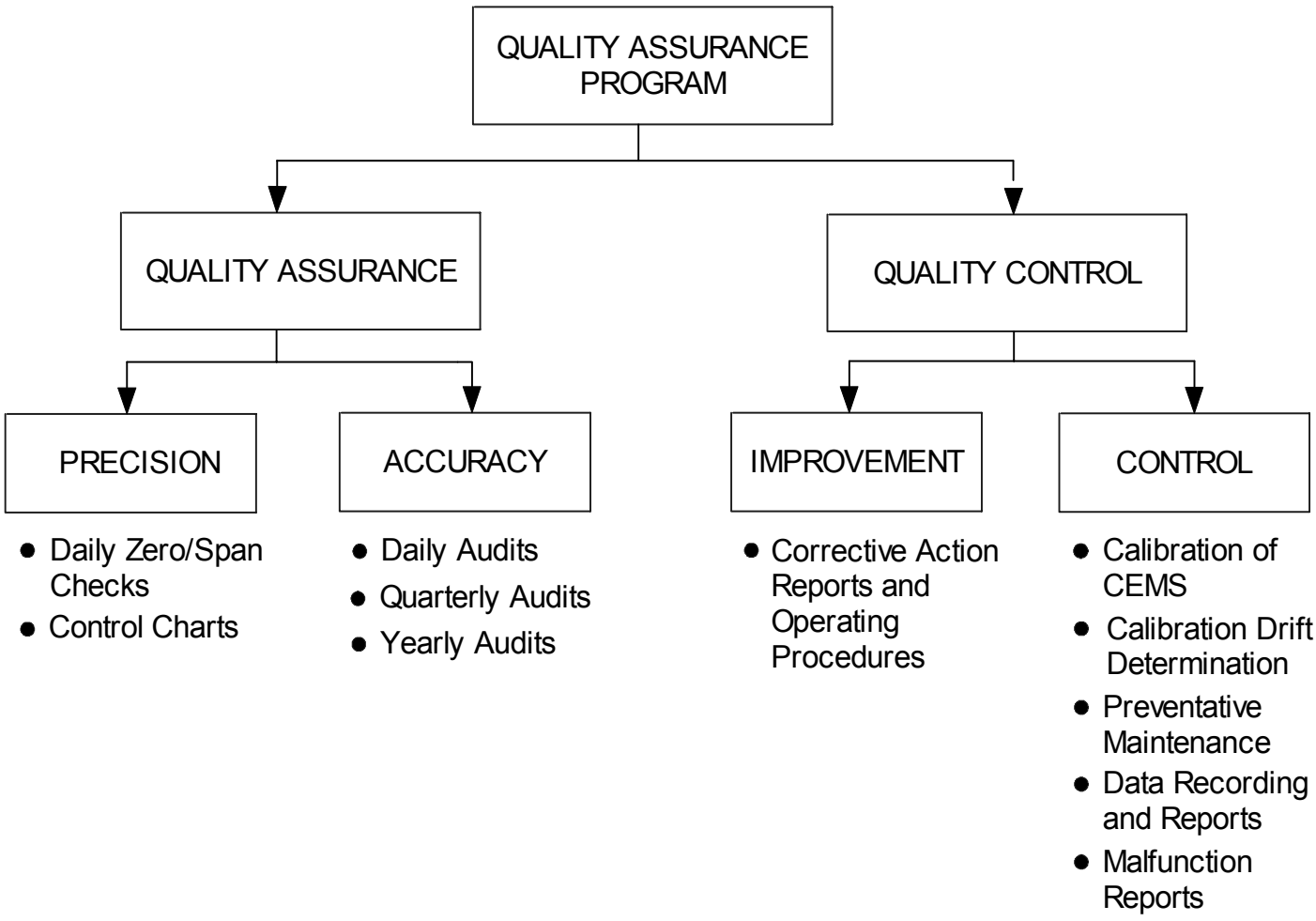


FIGURE 6. VALIDATING CEMS PERFORMANCE FOR PRECISION/ACCURACY

QUALITY ASSURANCE PROGRAM

This CAMDS Site Specific Quality Assurance program contains the following elements:

- Routine training for CEMS operators
- Routine monitoring of variables that may have an effect on the quality of the CEMS data
- Development of techniques to detect defects
- Development of methods and written procedures to qualify data
- Action strategies to increase the level or precision in the reported data and/or to detect equipment defects or degradation in equipment



Overall, this Quality Assurance Program involves the incorporation of the following three categories:

1. Management
2. Measurement and documentation
3. Data reduction, validation, analysis, and statistics

FIGURE 7. CAMDS SITE SPECIFIC QUALITY ASSURANCE.

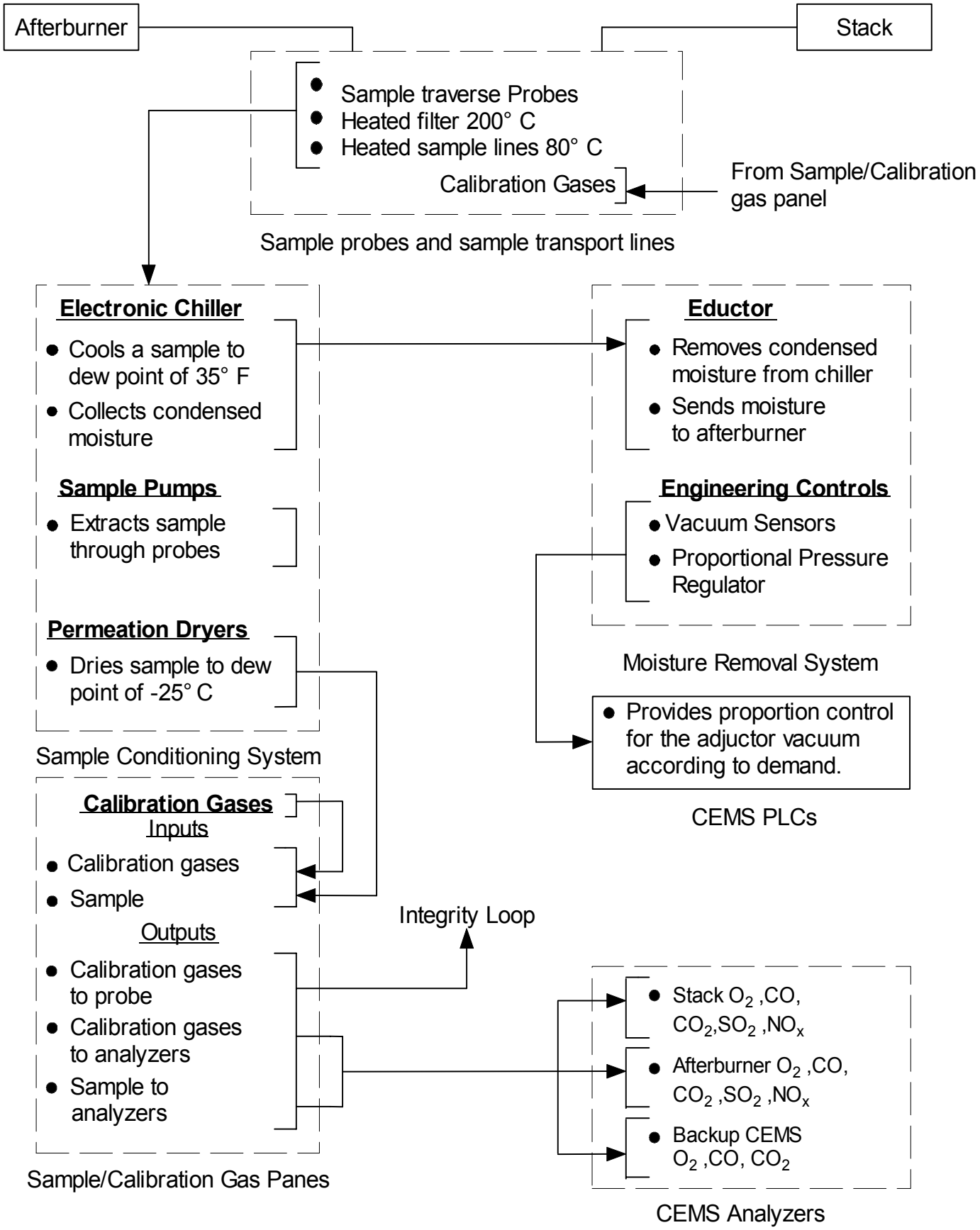
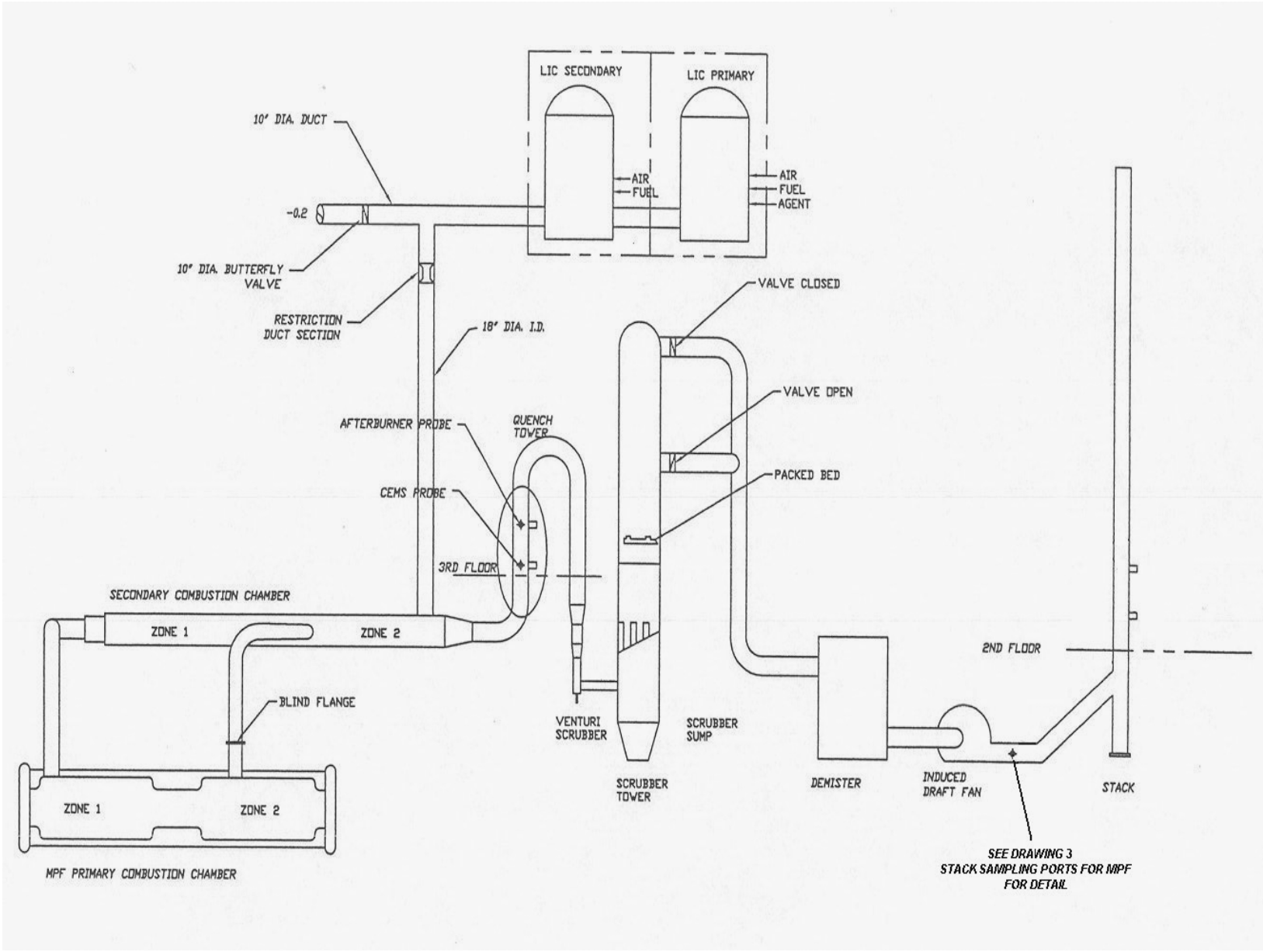


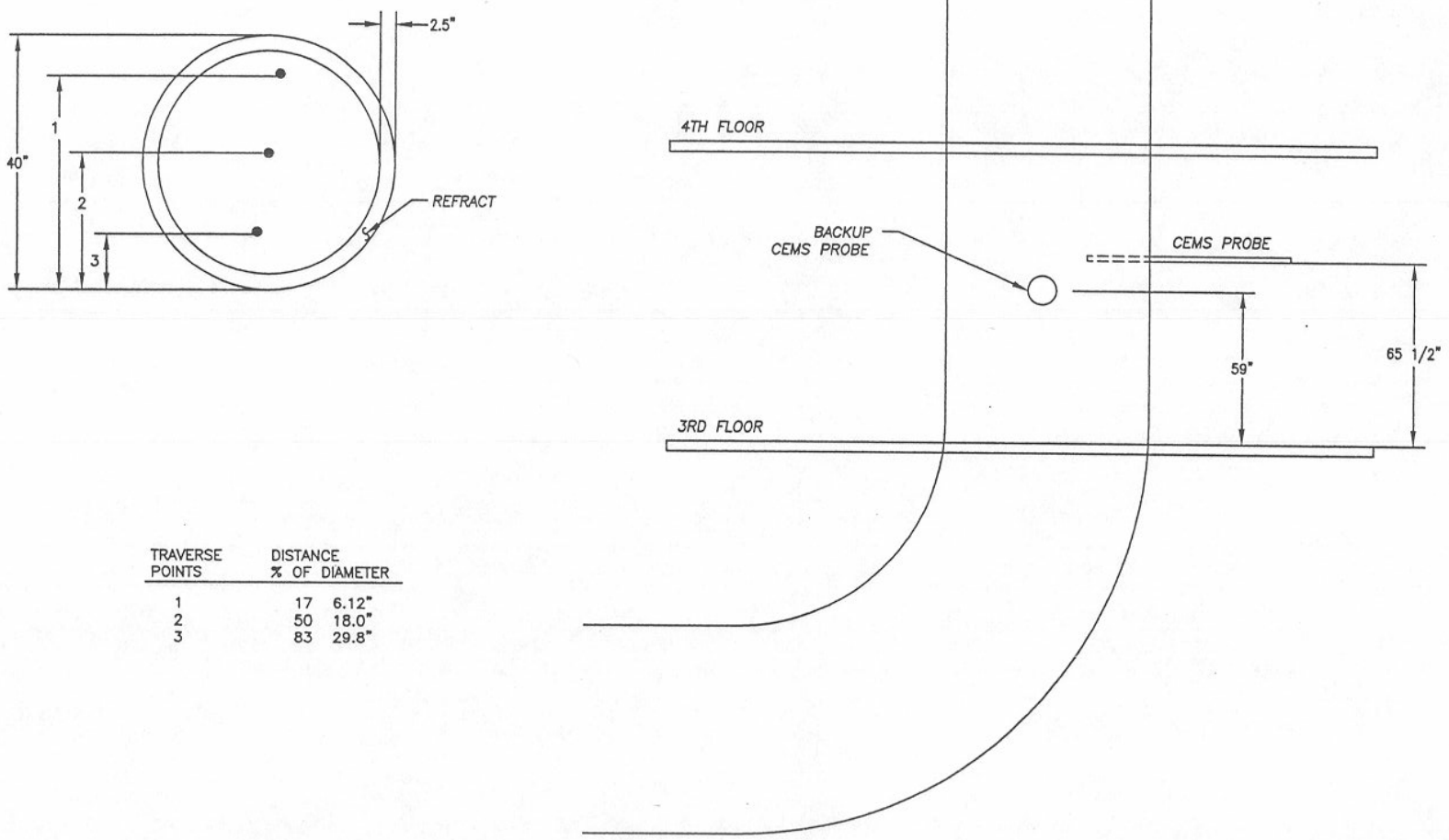
FIGURE 8. CEMS FLOW

APPENDIX D.
DRAWINGS

Site Plan 33-04E 18 July 2001

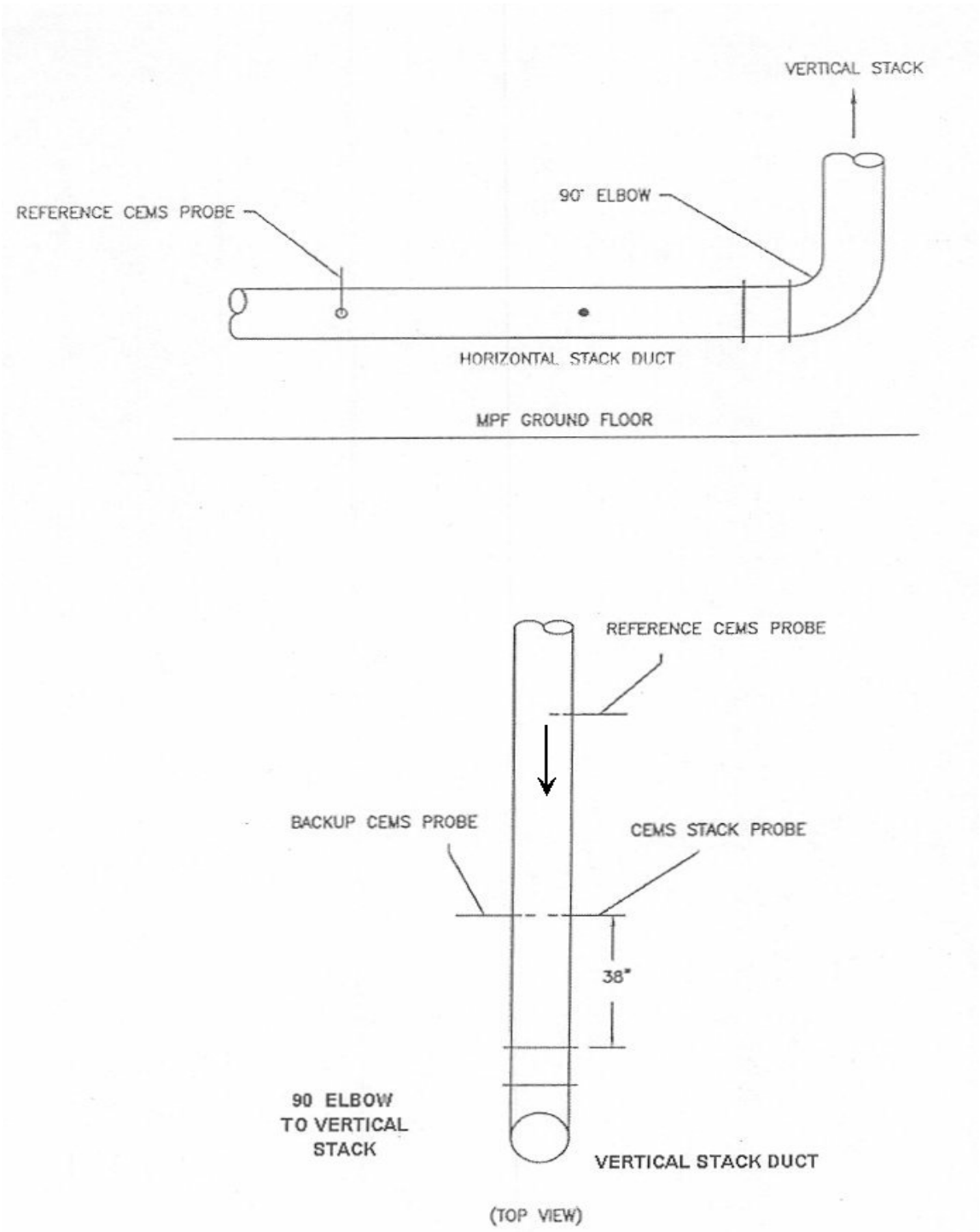


DRAWING 1. METAL PARTS FURNACE AND LIQUID INCINERATOR SAMPLING LOCATIONS.

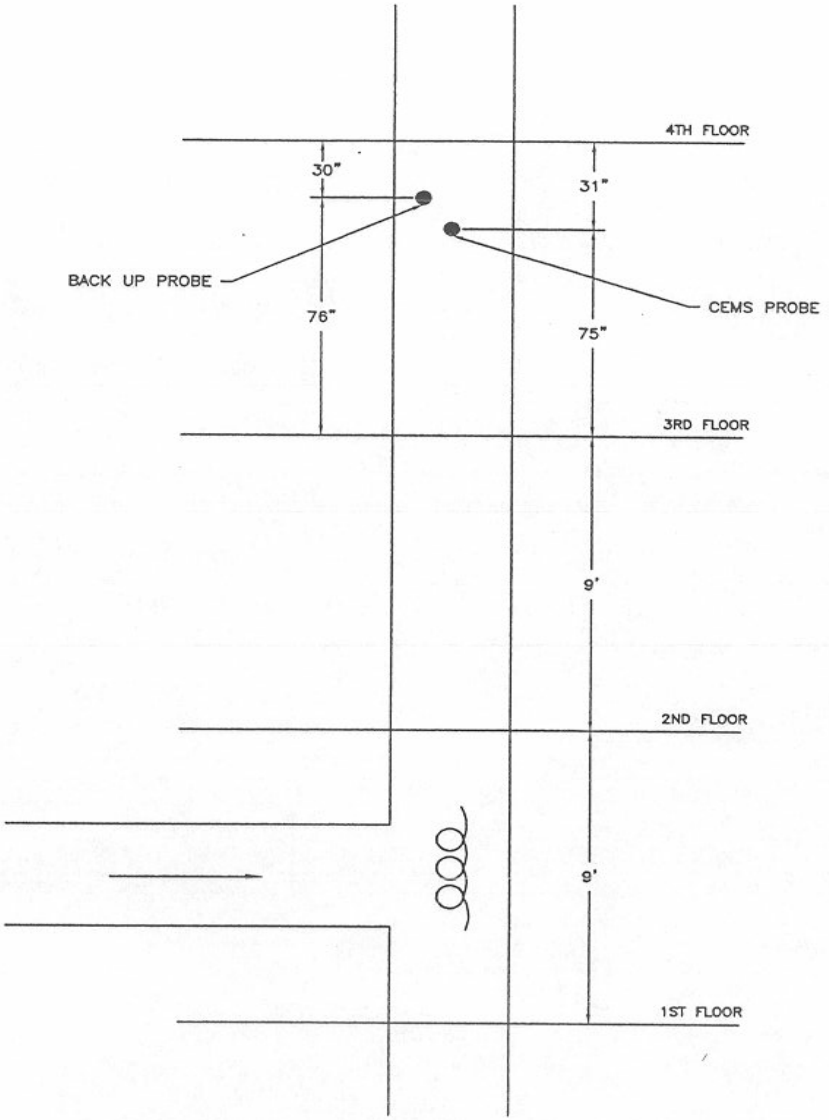


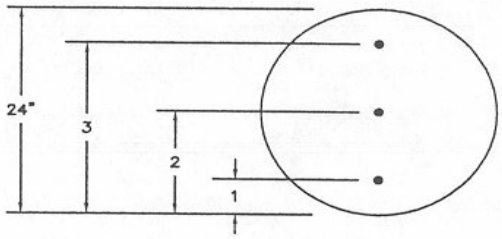
TRAVERSE POINTS	DISTANCE % OF DIAMETER	
1	17	6.12"
2	50	18.0"
3	83	29.8"

DRAWING 2. MPF AFTERBURNER SAMPLING PORTS



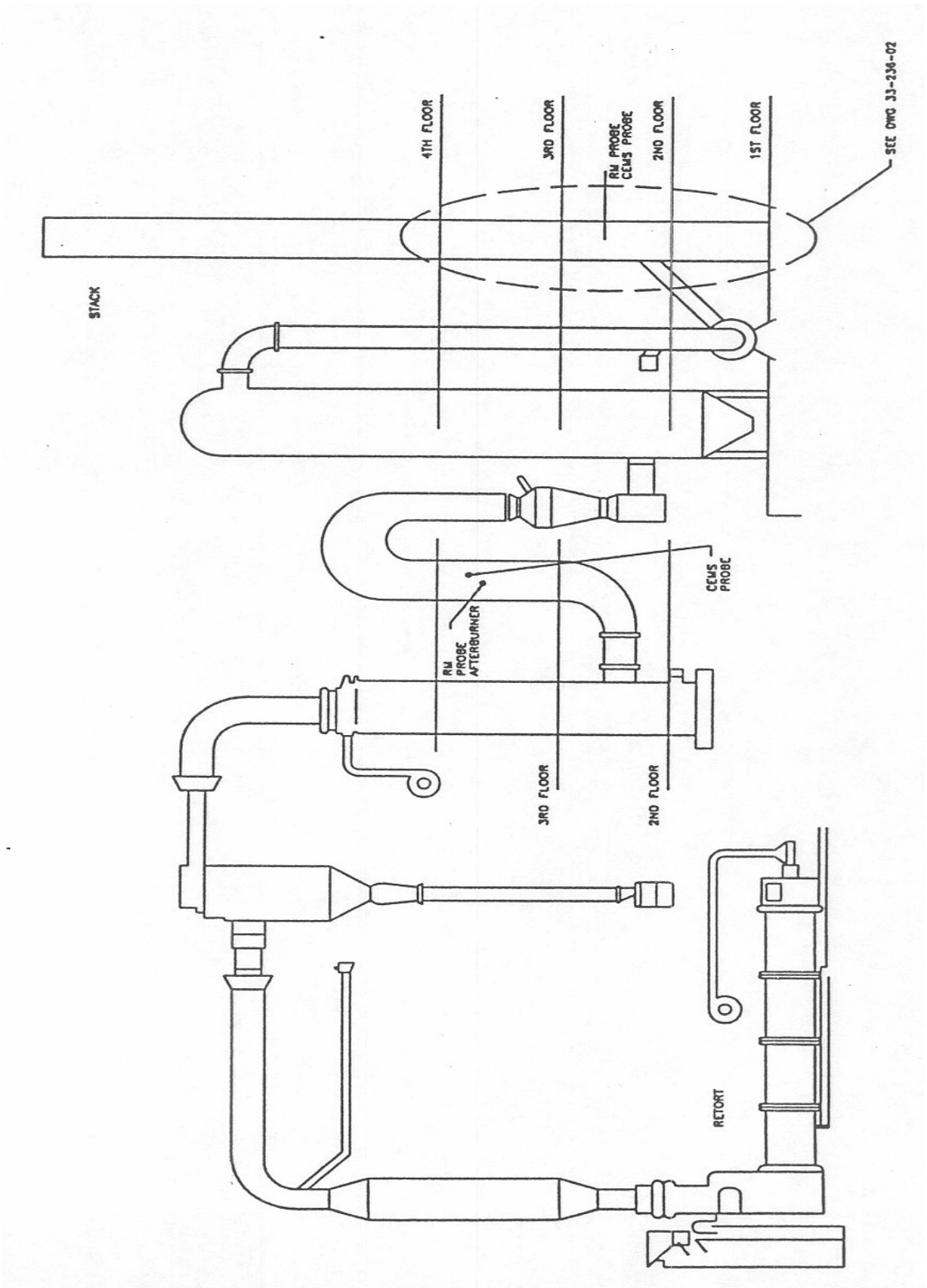
DRAWING 3. STACK SAMPLING PORTS FOR MPF



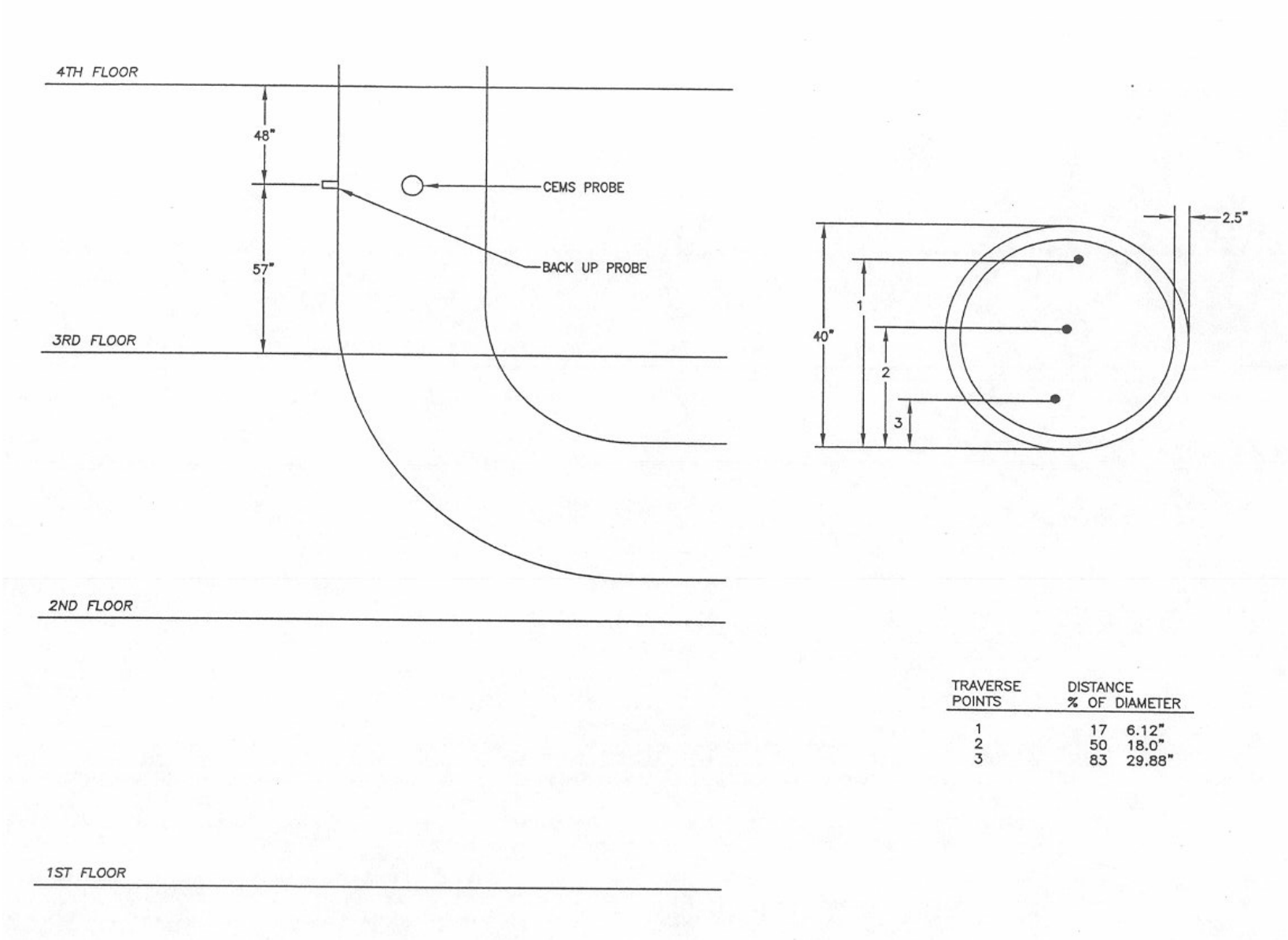


TRAVERSE POINTS	DISTANCE % OF DIAMETER
1	17.0
2	50.0
3	83.3

DRAWING 4. DEACTIVATION FURNACE SYSTEM STACK SAMPLING POINTS



DRAWING 5. DEACTIVATION FURNACE SYSTEM SAMPLING LOCATIONS



TRAVERSE POINTS	DISTANCE % OF DIAMETER	
1	17	6.12"
2	50	18.0"
3	83	29.88"

DRAWING 6. DEACTIVATION FURNACE AFTERBURNER CEMS SAMPLING PORTS

APPENDIX E. GLOSSARY

GLOSSARY

Section 1. Abbreviations

CAMDS	Chemical Agent Munitions Disposal System
CEMS	Continuous Emission Monitoring System
CFR	Code of Federal Regulations
CMO	Control Module Operator
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DFS	Deactivation Furnace System
EMD	Environmental Monitoring Division
EPA	Environmental Protection Agency
LED	Light Emitting Diode
MPF	Metal Parts Furnace
NDIR	Nondispersive Infrared
NO_x	Nitrogen Oxides
O_2	Oxygen
PLC	Programmable Logic Controller
PMCD	Program Manager for Chemical Demilitarization
PMD	Paramagnetic Detection
ppm	Parts Per Million
PTM	Performance Test Method
QA	Quality Assurance
QC	Quality Control
RA	Relative Accuracy
RCRA	Resource Conservation and Recovery Act
SO_2	Sulfur Dioxide
UPS	Uninterruptible Power Supply

Section 2. Terms

>	Greater Than
<	Less Than
%	Percent
□ C	Degrees Celsius
□ F	Degrees Fahrenheit
min	Minute(s)

Section 3. Special Abbreviations and Terms

CC	Confidence Coefficient
CD	Calibration Drift
CE	Calibration Error
CLD	Chemiluminescence Detection